HEATHKIT® MANUAL

HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information	(616) 982-3411
Credit	(616) 982-3561
Replacement Parts	(616) 982-3571

Technical Assistance Phone Numbers
8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only

R/C, Audio, and Electronic Organs	(616) 982-3310
Amateur Radio	(616) 982-3296
Test Equipment, Weather Instruments and Home Clocks	(616) 982-3315
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Computers — Software:	
Operating Systems, Languages, Utilities	(616) 982-3860
Application Programs	(616) 982-3884
Heath Craft Wood Works	(616) 982-3423

YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 90 days from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 90 days from the date of purchase, any malfunction caused by defective parts or error in design will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heathkit Electronic Center (units of Veritechnology Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORSEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's responsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment, (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

Heathkit® Manual

for the

25″ COLOR TV WITH REMOTE CONTROL

Model GR-2502

595-3134

WARNING: DO NOT EXPOSE THIS TV SET TO RAIN OR MOISTURE. NEVER OPERATE THE SET IF LIQUID HAS ACCIDENTLY SPILLED INTO IT. If this should happen, have your set checked by a qualified service technician before you use it again. Fire or electric shock could result.

NOTE: Be sure to read the "Television Safety Guide."

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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Federal Communications Commission requirements prescribe maximum RF radiation from Receivers operating above 30 MHz. This Television Receiver will meet these requirements when constructed in strict accordance with the instructions in this Manual, using only components and materials supplied with the kit or the exact equivalent thereof. In order to meet legal requirements, be certain to follow the instructions exactly as they are stated in this Manual.

INTRODUCTION

Your new Heathkit 25" Color Television is fast and easy to assemble, and will provide you with excellent performance, easy operation, and solid-state reliability. Most circuit boards and all critical assemblies are preassembled and factory aligned.

Many features, some of which are Heathkit exclusives, are standard with this Color Television. Some of these features are as follows:

- New Computer Brain — In a color television set, the blue, red and green electron guns in the CRT (picture tube) begin to wear through extended use, producing a washed-out picture with unnatural colors. However, in this set, the new CRT tracking system automatically maintains the colors in the CRT and keeps them at the original level throughout the life of the picture tube. The colors remain like new year after year.

- Quartz-Controlled Electronic Tuning — Ends the need for fine-tuning adjustments. The tuner instantly seeks out and locks on to the exact frequency you are tuned to. The picture always remains sharp and clear. Since the tuner is electronic, there are no moving parts to wear out and no contacts to corrode to cause picture problems.

- Timed Entry Channel Selection — Allows you to select a channel and after a three second delay, the channel will be tuned in automatically. For an immediate selection entry, select the channel and press the ENTER button.

- Infrared Remote Control — Allows you to turn the Television on and off, change the channel, control the volume level, recall the channel and time display, and operate the optional Space Phone and antenna switch. Infrared operation improves reliability and reduces inadvertent operation due to noise.

- Up/Down Channel Scanning — Allows you to scan your favorite channels in an up or down sequence. Once programmed, a microcomputer "remembers" your favorite channels, for tuning ease and convenience.

- On Screen Channel Number Display — Shows you the channel number you are watching and the time. The display will show for approximately 4-1/2 seconds whenever you change channels or whenever you press the RECALL button on your remote control unit or the TV's main keyboard.

- 178-Channel Capability — Allows you to select all VHF/UHF and 122 cable channels without the need for an external converter (except scrambled programs). It selects all 68 standard broadcast VHF-UHF channels, and 12 VHF and 98 midband/superband/hyperband/ultraband cable channels.

- Phase-Lock Loop Tuning — "Locks-in" the signal for normal TV operation when switched to the NORM position. In the SPCL (special) position, the tuner pulls in off-frequency signals that may be received from cable antenna systems, Master Antenna (MATV) systems, video games, or other signal sources.

- Automatic Degaussing Circuit — Helps maintain color purity by demagnetizing the picture tube every time you turn the Television on.

- An Electronic Power Sentry Voltage Regulator — Helps conserve energy and maintain stable voltage to the Television circuits.

- A Special Video Filter — (When switched in) removes excess picture static (sometimes called "picture noise or snow") to give you a clearer picture, even under weak signal conditions.

- A Redi-Plug — Access port allows easy connection of future accessories such as a Stereo TV adapter, Teletext decoder, and selected cable TV decoders.

- Advanced Space Phone Auto Dialing (Optional GRA-2502-1) — Allows you to program two 13-digit telephone numbers from your Space Command remote control unit. These numbers can be stored by the microprocessor and recalled later and automatically redialed at any time.

- Magic-Touch Tuning — Features a "membrane" keypad control panel with quick response action. Just press the keypad on the panel to activate the desired functions.

- Stereo Power Amplifier — With an output of 5-watts RMS power per channel from 100 Hz to 10,000 Hz into 8 ohms with 2% or less total harmonic distortion.

- Choice of Installation — Enables you to mount your Television in a wall, in your own cabinet, or in one of the Heath TV cabinets.

- Crosshatch Generator — For performing convergence and color purity adjustments.

- Comb Filter — For greater picture resolution.

- Stereo Control Center — Features separate 21 stepped position bass and treble controls, a balance control to adjust the left and right levels, a hi-filter switch circuit to help eliminate high frequency noise, and a mode switch for AUX (auxiliary) STEREO or TV audio.

- A Four-Speaker Sound System — Which includes two 5″ × 7″ oval speakers for mid and bass frequencies and two 2″ tweeters for clean, clear, high frequencies.

- Video/Audio, Input/Output Jacks — Allow you to connect optional equipment to the TV. This multifunction set can be used as a color TV, a video monitor, or as a source of video and audio signal for VCR equipment. You can also use video cameras, video disc players, home video games, home computers, and video cassette recorders with your TV Set. The built-in stereo power amplifier allows you to listen to stereo sound from your console stereo, stereo video disc player, stereo video cassette recorder units, and other devices equipped with stereo sound through the four TV Set speakers. The Video and Audio jacks on the back panel can be used as a recording source for video cassette recorders.

The GR-2502, 25″ Color TV with remote control and all of its advanced features is designed for many years of convenient entertainment and trouble-free performance.

UNPACKING INSTRUCTIONS

Do NOT unpack your kit until you are instructed to do so.

WARNING: Do not make adjustments to the prewired circuit board modules. These modules were tested and adjusted at the factory and must not be readjusted unless you are specifically instructed to do so in this Manual.

This 25″ Color TV kit is packed in two cartons. One contains the picture tube and the other contains the remaining parts of your Television. Set the picture tube carton aside until it is called for later.

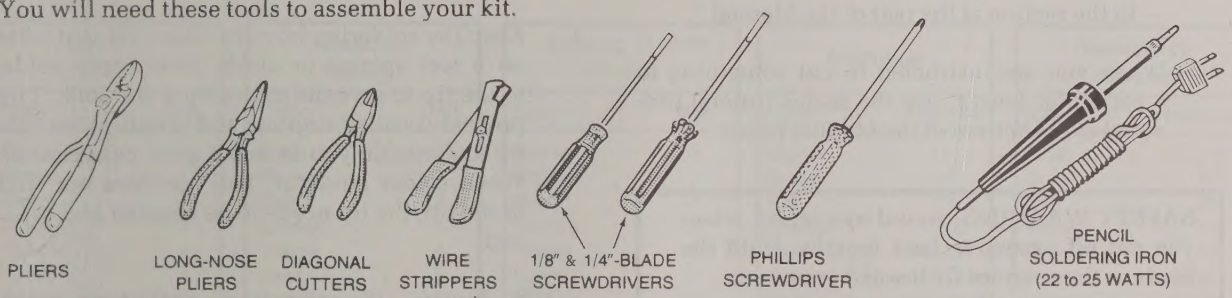
The carton marked "GR-2502" contains "Pack 1," a number of other boxes, and some loose parts. After you remove Pack 1 from the carton, all of the remaining boxes and parts are considered to be the "Final Pack."

Instructions at the beginning of each Parts List tells you which pack to open. You will also be directed to remove certain parts from the final pack.

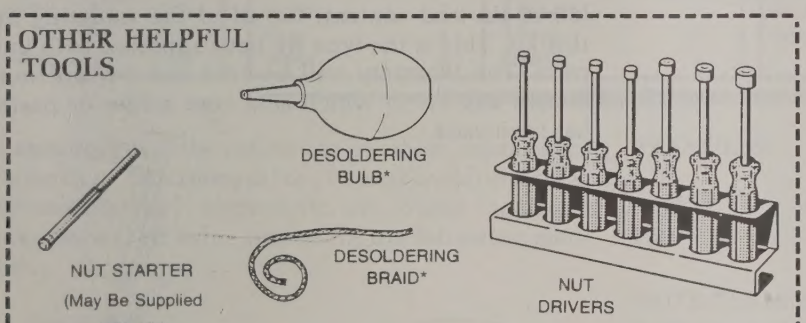
ASSEMBLY NOTES

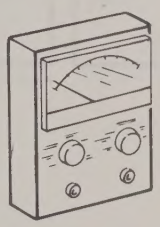
TOOLS

You will need these tools to assemble your kit.



OTHER HELPFUL TOOLS





VOM OR VTVM OR DVM

ASSEMBLY

1. Follow the instructions carefully. Read the entire step before you perform each operation.

2. The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.

3. Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.

4. Position all parts as shown in the Pictorials.

5. Solder a part or a group of parts only when you are instructed to do so.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

   — In the Parts List,

   — At the beginning of each step where a component is installed,

   — In some illustrations,

   — In the Schematic,

   — In the section at the rear of the Manual.

7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excessive lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

It is easy to make a good solder connection if you follow a few simple rules:

1. Use the right type of soldering iron. A 22 to 25-watt pencil soldering iron with a 1/8″ or 3/16″ chisel or pyramid tip works best.

2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

NOTE: Always use rosin core, radio-type solder (60:40 tin-lead content) for all of the soldering in this kit. This is the type we have supplied with the parts. The Warranty will be void and we will not service any kit in which acid core solder or paste has been used.

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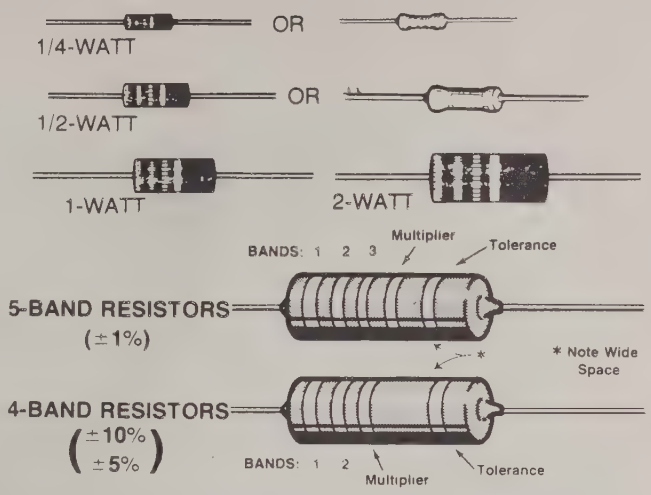
PARTS

Resistors are identified in Parts Lists and steps by their resistance value in Ω (ohms), kΩ (kilohms), or MΩ (megohms). They are usually identified by a color code and four or five color bands, where each color represents a number. These colors (except for the last band, which indicates a resistor's "tolerance") will be given in the steps in their proper order. Therefore, the following color code is given for information only. NOTE: Occasionally, a "precision" or "power" resistor may have the value stamped on it.



Band 1 1st Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

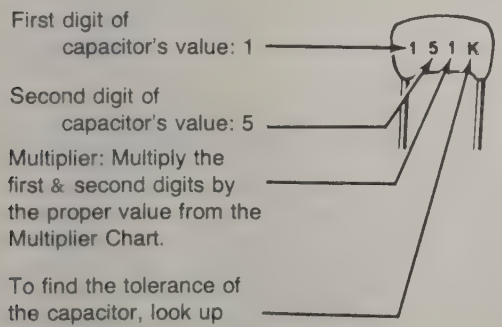
Band 2 2nd Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

Band 3 (if used) 3rd Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

Multiplier	
Color	Multiplier
Black	1
Brown	10
Red	100
Orange	1,000
Yellow	10,000
Green	100,000
Blue	1,000,000
Silver	0.01
Gold	0.1

Resistance Tolerance	
Color	Tolerance
Silver	± 10%
Gold	± 5%
Red	± 2%
Brown	± 1%
Green	± .5%
Blue	± .25%
Violet	± .1%
Gray	± .05%

Capacitors will be called out by their capacitance value in μF (microfarads) or pF (picofarads) and type: ceramic, Mylar*, electrolytic, etc. Some capacitors may have their value printed in the following manner:


First digit of capacitor's value: 1
Second digit of capacitor's value: 5
Multiplier: Multiply the first & second digits by the proper value from the Multiplier Chart.
To find the tolerance of the capacitor, look up this letter in the Tolerance columns.
151K

EXAMPLES:

151K = 15 × 10 = 150 pF
759 = 75 ×0.1 = 7.5 pF

NOTE: The letter "R" may be used at times to signify a decimal point: as in: 2R2 = 2.2 (pF or μF).

MULTIPLIER		TOLERANCE OF CAPACITOR		
FOR THE NUMBER:	MULTIPLY BY.	10 pF OR LESS	LETTER	OVER 10 pF
0	1	±0.1 pF	B	
1	10	±0.25 pF	C	
2	100	±0.5 pF	D	
3	1000	±1.0 pF	F	±1%
4	10,000	±2.0 pF	G	±2%
5	100,000		H	±3%
			J	±5%
8	0.01		K	±10%
9	0.1		M	±20%

*DuPont Registered Trademark.

CROSSHATCH CIRCUIT BOARD

PARTS LIST

Open the box marked "PK 1." Then unpack Pack #1 and check each part against the following list. Return any part that is in an individual envelope back into the envelope after you have identified it, until that part is called for in a step. Do not throw away any packing material until you account for all the parts.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

TAPED COMPONENTS

NOTE: The following resistors and diodes are taped on a strip which was checked before shipment. Since these parts are taped in the order of assembly, it is not necessary to check them against the following list.

RESISTORS

NOTE: All resistors are 1/4-watt, with a tolerance of 5% (fourth band gold) unless otherwise noted.

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
6-221-12	1	220 Ω (red-red-brn)	R919
6-511	1	510 Ω, 1/2-watt (grn-brn-brn)	R921
6-222-12	1	2200 Ω (red-red-red)	R923
6-272-12	1	2700 Ω (red-viol-red)	R917
6-332-12	2	3300 Ω (org-org-red)	R902, R905
6-472-12	1	4700 Ω (yel-viol-red)	R924
6-682-12	1	6800 Ω (blu-gry-red)	R909
6-103-12	4	10 kΩ (brn-blk-org)	R907, R914, R916, R922

Resistors (Cont'd.)

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
6-153-12	3	15 kΩ (brn-grn-org)	R903, R908, R915
6-273-12	1	27 kΩ (red-viol-org)	R912
6-333-12	2	33 kΩ (org-org-org)	R901, R904
6-104-12	2	100 kΩ (brn-blk-yel)	R906, R913
6-154-12	1	150 kΩ (brn-grn-yel)	R918

DIODES

56-36	1	Zener	D905
56-56	2	1N4149	D901, D902

NON-TAPED PARTS

NOTE: The following parts are not taped on strips. The key numbers correspond to the numbers on "Crosshatch Circuit Board Parts Pictorial" (Illustration Booklet, Pages 1 and 2).

CAPACITORS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	20-118	1	15 pF mica	C903
A1	20-115	1	300 pF mica	C902
A2	27-47	4	.1 μF Mylar	C901, C905, C906, C907
A3	25-885	1	100 μF electrolytic	C904

TRANSISTORS – INTEGRATED CIRCUITS (ICs)

NOTE: Transistors and integrated circuits may be marked for identification in any one of the following four ways:

1. Part number.
2. Type number. (For integrated circuits, this refers only to the numbers and letters shown in **BOLD** print in the Parts List. Disregard any other numbers or letters shown on the IC.)
3. Part number and type number.
4. Part number with a type number other than the one shown.

CAUTION: Some of the integrated circuits can be easily damaged by static electricity. DO NOT remove any ICs from their foam pads until you are instructed to do so in a step.

B1	417-801	5	MPSA20 transistor	Q901 – Q905
B2	443-603	1	CD**4011** or **14011** IC	U901
B2	443-737	1	MC**14518** IC or 4518	U902
B2	443-777	1	MC**14528** or **4098** IC	U903

WIRE

344-50	15"	Black
344-52	15"	Red
344-54	15"	Yellow
344-55	15"	Green
344-56	15"	Blue
344-57	15"	Violet

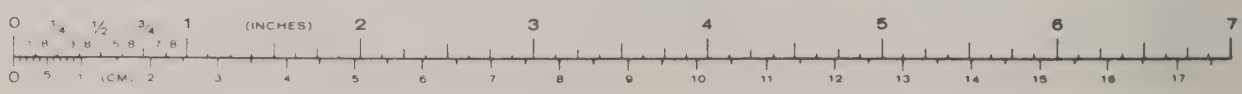
LABELS*

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
C1	235-481	1	Volume caution label	
C2	235-483	1	.187-ampere fuse replacement label	
C3	235-484	1	4.00-ampere fuse replacement label	
C4	235-486	1	X-Ray Warning label	
C5	235-487	1	General fuse replacement label	
C6	235-488	1	Shock hazard warning label	
C7	235-511	1	Heath nameplate	
C8	235-559	1	Ground label	
C9	390-1192	2	Manufacturing date label	
C10	390-1255	2	Fuse replacement label	
C11	390-2579	1	Power consumption label	
C12		1	Blue and white label	

MISCELLANEOUS

D1	10-312	1	10 kΩ control	R911
D2	60-645	1	Slide switch	SW901
	85-2903-1	1	Crosshatch circuit board	
D3	432-162	7	Male pins (includes one extra)	
D4	432-163	7	Female pins (includes one extra)	
D5	432-836	1	Male connector	
D6	432-837	1	Female connector shell	
D7	434-298	1	14-pin IC socket	
D7	434-299	2	16-pin IC socket	
D8	354-5	1	3-3/4" cable tie	
	597-260	1	Parts Order Form*	
	597-1766	1	Television Safety Guide*	
		1	Taped Component Chart*	
		1	Assembly Manual (see title page for part number.)	
			Solder	

* These items are packed inside the Manual. Set them aside for use later.



STEP-BY-STEP ASSEMBLY

START

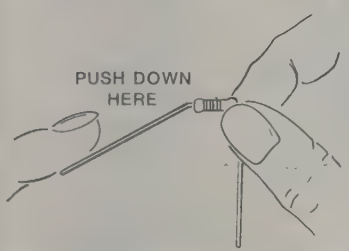
In the following steps, you will be given detailed instructions on how to install and solder the first part on the circuit board. Read and perform each step carefully. Then use the same procedure whenever you install parts on a circuit board.

( ) Position the crosshatch circuit board as shown with the printed side (not the foil side) up.

NOTE: When you install a component that has its value printed on it, position the value marking up, so it can be easily read. Diodes should be mounted with their type or part number up, if possible.

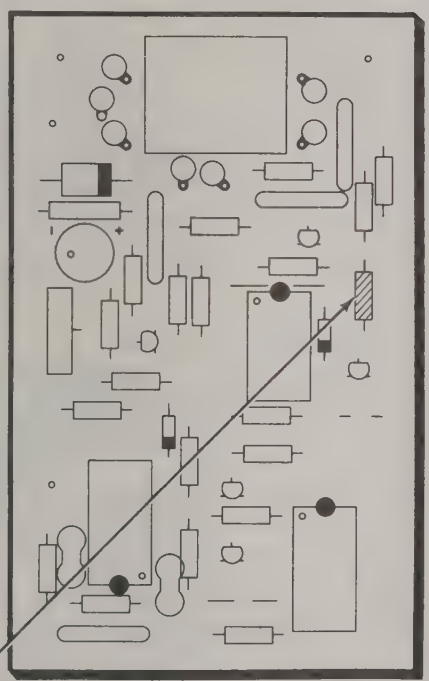
Refer to the instructions on the "Taped Components Chart." Then install the following parts from the taped strip.

( ) Hold a 15 kΩ (brn-grn-org) resistor and bend the leads straight down to fit the hole spacing in the circuit board.



( ) R903: Push the leads through the holes at the indicated location on the circuit board.

( ) Press the resistor against the circuit board. Then bend the leads outward slightly to hold the resistor in place.

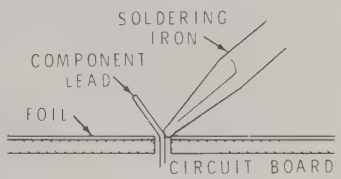


PICTORIAL 1-1

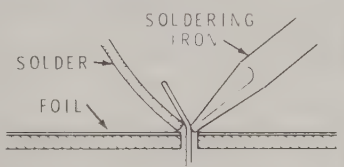
CONTINUE

( ) Solder the resistor leads to the circuit board as follows:

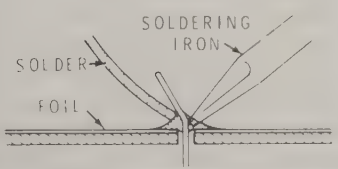
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.



2. Then apply solder to the other side of the connection. IMPORTANT: Let the heated lead and the circuit board foil melt the solder.



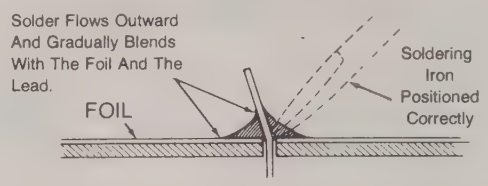
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



( ) Cut off the excess lead lengths close to the connection. WARNING: Clip the leads so the ends will not fly toward your eyes.

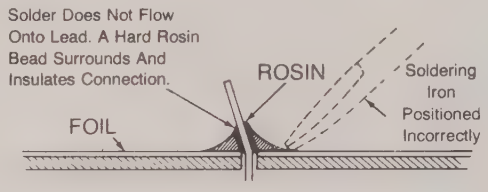
( ) Check each connection. Compare it to the illustration on Page 14. After you have checked the solder connections, proceed with the assembly on Page 15. Use the same soldering procedure for each connection.

A GOOD SOLDER CONNECTION

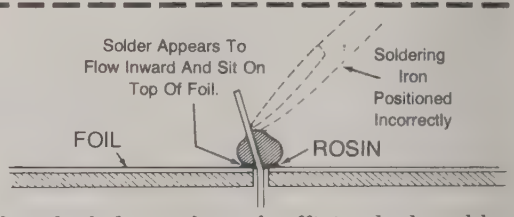


When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS


Solder Does Not Flow Onto Lead. A Hard Rosin Bead Surrounds And Insulates Connection.
ROSIN
FOIL
Soldering Iron Positioned Incorrectly

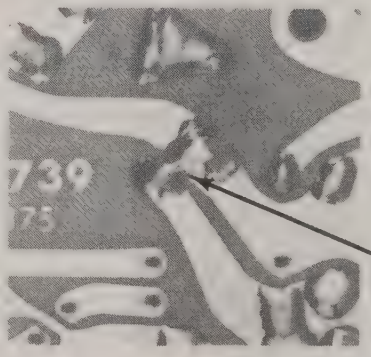
When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.



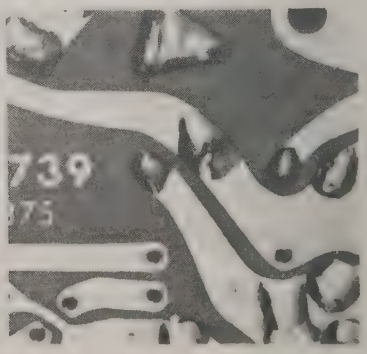
When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER BRIDGES

A solder bridge between two adjacent foils is shown in photograph **A**. Photograph **B** shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is: always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area and does not bridge to another foil. This is especially important when the foils are small and close together. NOTE: It is alright for solder to bridge two connections on the same foil.



Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. NOTE: The foil side of most circuit boards has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.



START

NOTE: Make sure you installed the resistor in Pictorial 1-1 on Page 13.

( ) R913: 100 kΩ (brn-blk-yel).

( ) R921: 510 Ω, 1/2-watt (grn-brn-brn).

( ) R923: 2200 Ω (red-red-red).

( ) R912: 27 kΩ (red-viol-org).

( ) R909: 6800 Ω (blu-gry-red).

( ) R922: 10 kΩ (brn-blk-org).

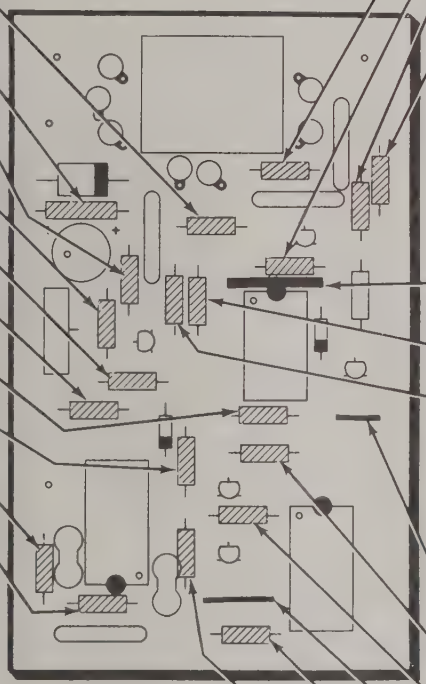
( ) R904: 33 kΩ (org-org-org).

( ) R918: 150 kΩ (brn-grn-yel).

( ) R917: 2700 Ω (red-viol-red).

( ) R916: 10 kΩ (brn-blk-org).

( ) Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 1-2

CONTINUE

( ) R914: 10 kΩ (brn-blk-org).

( ) R915: 15 kΩ (brn-grn-org).

( ) R901: 33 kΩ (org-org-org).

( ) R902: 3300 Ω (org-org-red).

NOTE: When a wire is called for, cut the wire to the indicated length and then remove 1/4" of insulation from each end. Solder the ends of the wires as you install them and cut off the excess wire lengths.

( ) 1-1/8" black wire.

( ) R924: 4700 Ω (yel-viol-red).

( ) R919: 220 Ω (red-red-brn).

( ) Remove all of the insulation from a 1-3/4" yellow wire. Use this wire when a step calls for bare wire.

( ) 3/4" bare wire.

( ) R905: 3300 Ω (org-org-red).

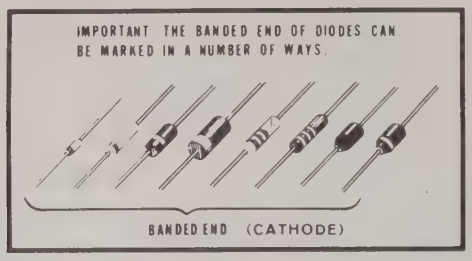
( ) R906: 100 kΩ (brn-blk-yel).

( ) 1" bare wire.

( ) R907: 10 kΩ (brn-blk-org).

( ) R908: 15 kΩ (brn-grn-org).

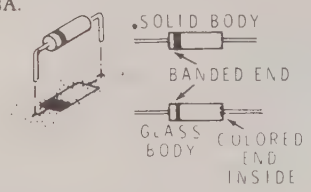
( ) Solder the leads to the foil and cut off the excess lead lengths.



Detail 1-3A

START

NOTE: When you install a diode, always match the band on the diode with the band mark on the circuit board. THE CIRCUIT WILL NOT WORK PROPERLY IF A DIODE IS INSTALLED BACKWARDS. See Detail 1-3A.



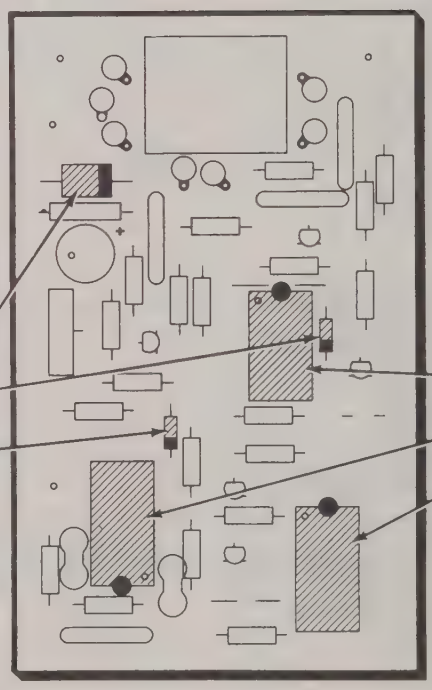
If your diode has a solid body, the band is clearly defined. If your diode has a glass body, do not mistake the colored end inside the diode for the banded end. Look for a band painted on the outside of the glass.

( ) D905: Zener diode (#56-36).

( ) D901: 1N4149 diode (#56-56).

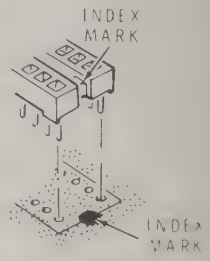
( ) D902: 1N4149 diode (#56-56).

( ) Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

NOTE: When you install an IC socket, be sure the index mark is still visible after the socket is installed. Then solder the pins to the foil. Do NOT install a 14-pin socket at a 16-pin socket location.



( ) 14-pin IC socket at U901.

( ) 16-pin IC socket at U903.

( ) 16-pin IC socket at U902.

PICTORIAL 1-3

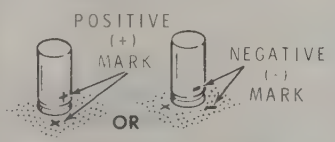
START

( ) C901: .1 μF Mylar.

( ) C905: .1 μF Mylar.

( ) C907: .1 μF Mylar.

NOTE: When you install an electrolytic capacitor, be sure to match the positive (+) mark on the capacitor with the positive (+) mark on the circuit board, or match the negative (−) mark on the capacitor with the negative (−) mark on the circuit board.



( ) C904: 100 μF electrolytic.

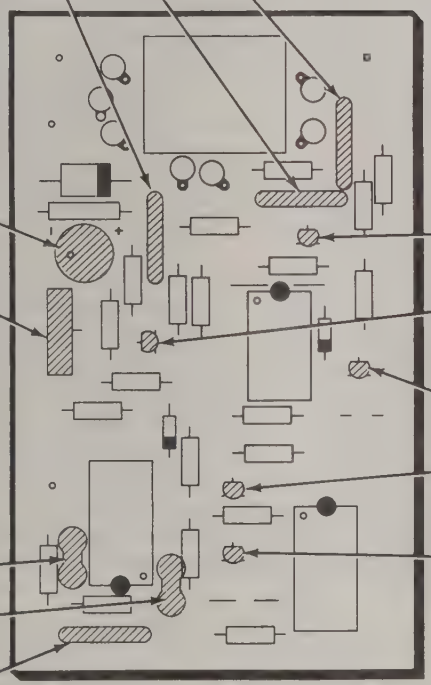
( ) R911: 10 kΩ control. Solder the lugs to the foil.

( ) C903: 15 pF mica.

( ) C902: 300 pF mica.

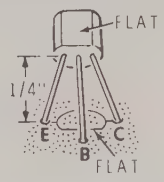
( ) C906: .1 μF Mylar.

( ) Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

NOTE: When you install a transistor in each of the following steps, align its flat with the flat on the circuit board. Insert the leads into their correct holes. Position the transistor 1/4" above the circuit board. Then solder the leads to the foil and cut off the excess lead lengths.



( ) Q904: MPSA20 transistor (#417-801).

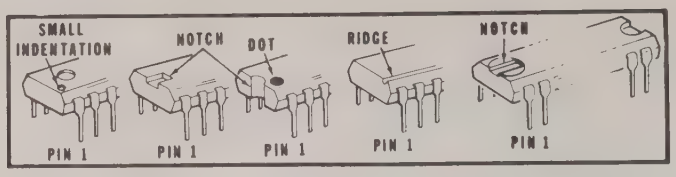
( ) Q905: MPSA20 transistor (#417-801).

( ) Q901: MPSA20 transistor (#417-801).

( ) Q902: MPSA20 transistor (#417-801).

( ) Q903: MPSA20 transistor (#417-801).

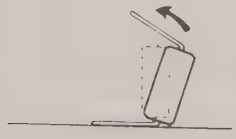
PICTORIAL 1-4



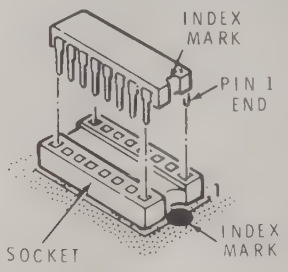
CAUTION: Integrated Circuits (IC's) are complex electronic devices that perform many complicated functions in the circuit. Read all of the following information before you install the IC's.

The pins on the IC's may be bent out at an angle, so they do not line up with the holes in the IC socket. DO NOT try to install an IC without first bending the pins as described below. To do so may damage the IC pins or the socket, causing intermittent contact.

Before you install an IC, lay it down on its side as shown below and very carefully roll it toward the pins to bend the lower pins into line. Then turn the IC over and bend the pins on the other side in the same manner.



Make sure that the pin 1 end of the IC is positioned over the index mark on the circuit board (see the detail at the top of this page). Also make sure that all of the pins are started into the socket. Then press the IC firmly into the socket. NOTE: An IC pin can become bent under the IC and it will appear as though it is correctly installed in the socket.



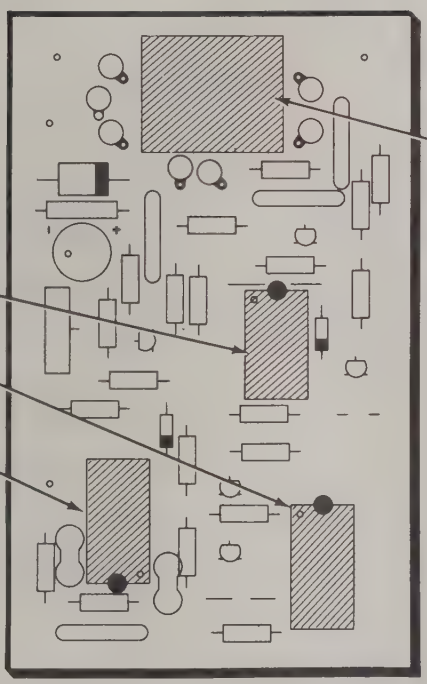
Some IC's are packed in conductive foam and are called "protected IC's." They can be damaged by static electricity. Once you remove a protected IC from its protective foam packing, DO NOT lay the IC down or let go of it until it is installed in its socket. When you bend the leads of a protected IC, hold the IC in one hand and place your other hand on your work surface before you touch the IC to your work surface. This will equalize the static electricity between the work surface and the IC.

START

( ) U901: CD**14011**AE IC (#443-603) at U901.

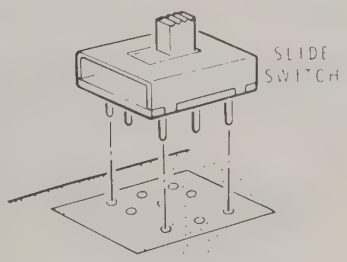
( ) U902: MC**14518** IC (#443-737) at U902.

( ) U903: MC1**4528** or **4098** IC (#443-777) at U903.

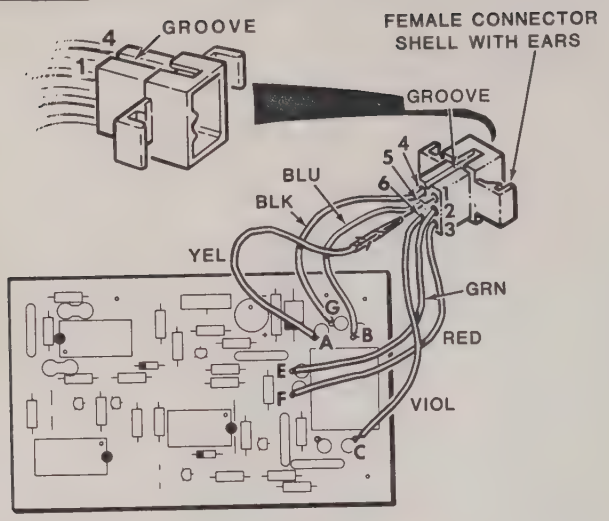


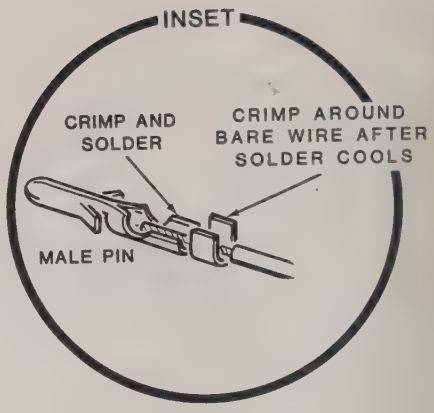
CONTINUE

( ) SW901: Slide switch. Make sure the switch lugs are fully seated in their holes; then solder the lugs to the foil.



PICTORIAL 1-5





PICTORIAL 1-6

Refer to Pictorial 1-6 for the following steps.

NOTE: When you are instructed to prepare a solid wire, as in the following step, cut it to the indicated length and remove 1/4″ of insulation from the ends.

( ) Prepare the following wires:

4″ black
4″ red
4″ yellow
4″ green
4″ blue
4″ violet

( ) Refer to the inset drawing and crimp and solder a male pin on one end of each of the prepared wires.

In the following steps, insert the male pins on the end of the prepared wires into the female connector shell with ears as follows. Push each pin into its connector shell hole until you hear a faint locking "click." Then gently pull on the wire to make sure it has locked in place. The hole numbers are stamped next to the holes.

( ) Yellow wire into hole 1.

( ) Green wire into hole 2.

( ) Red wire into hole 3.

( ) Black wire into hole 4.

( ) Blue wire into hole 5.

( ) Violet wire into hole 6.

Connect the free ends of the wires to the circuit board as follows. After you install a wire, solder it to the foil and cut off the excess wire length.

( ) Red wire to hole F.

( ) Green wire to hole E.

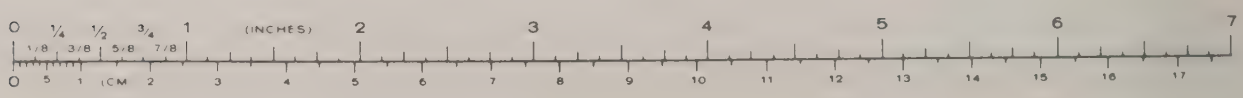
( ) Yellow wire to hole A.

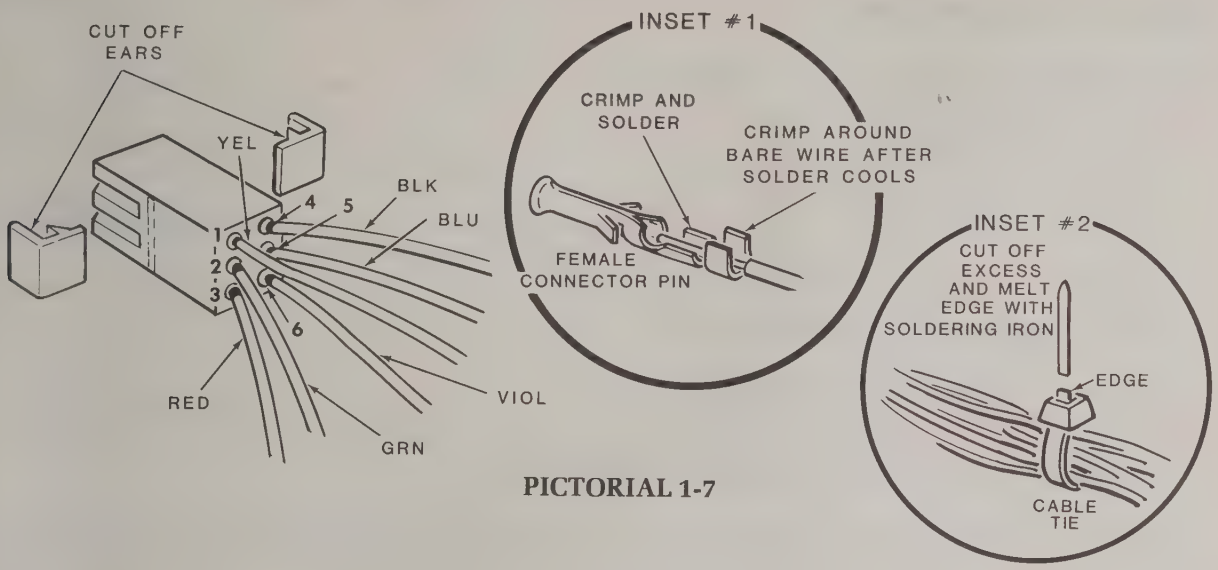
( ) Black wire to hole G.

( ) Blue wire to hole B.

( ) Violet wire to hole C.

NOTE: Hole D will not be used.





PICTORIAL 1-7

Refer to Pictorial 1-7 for the following steps.

( ) Prepare the following wires:

9″ yellow
9″ black
9″ blue
11″ red
11″ green
11″ violet

( ) Crimp and solder a female pin on one end of each of the prepared wires as shown in inset drawing #1.

Insert the female pins on the end of the prepared wires into the male connector as follows. Push the pin into its connector shell hole until you hear a faint locking "click." Then gently pull on the wire to make sure it has locked in place. The hole numbers are stamped next to the holes.

( ) Yellow wire into hole 1.

( ) Green wire into hole 2.

( ) Red wire into hole 3.

( ) Black wire into hole 4.

( ) Blue wire into hole 5.

( ) Violet wire into hole 6.

( ) Cut the ears off the male connector.

( ) Install a cable tie around the six wires at the center and cut off the excess cable tie as shown in inset drawing #2. Then use your soldering iron to melt the sharp end to prevent a possible scratch when you work inside the set.

You will connect the remaining wire ends later. Set the male connector assembly aside until it is called for.

CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following most commonly made errors.

( ) Unsoldered connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns.

( ) Protruding leads which could touch together.

Refer to the illustration where the parts were installed as you make the following visual checks.

( ) Diodes for the proper type and installation.

( ) Transistors for the proper type and installation.

( ) ICs for the proper type and installation.

( ) Electrolytic capacitors for the correct position of the (+) and (−) marked ends.

Set the circuit board aside until it is called for later. Discard any left over wire.

CHASSIS

PARTS LIST

NOTE: When you unpack the remainder of the kit, be careful not to damage the smaller parts (speakers, etc.).

Remove the remaining Parts from the carton and check each part against the following list. The key numbers correspond to the numbers on the "Chassis Parts Pictorial" (Illustration Booklet, Pages 2 through 6). Return any part that is in an individual envelope back into the envelope after you have identified it, until that part is called for in a step. Do not throw away any packing material until you account for all the parts.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

CIRCUIT MODULES AND ASSEMBLIES

NOTE: The circuit modules are assembled, tested, and aligned. No NOT make adjustments on these modules unless specifically instructed to do so in the Manual. To do so will void your Warranty.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
A1	235-448	1	Sweep module
A2	235-461	1	CRT socket module
A3	235-463	1	Main module
A4	235-464	1	Tuner control module
A5	235-500	1	VHF/UHF Tuner
A6	235-521	1	Control assembly
A7	235-525	1	Slide switch assembly
A8	235-526	1	Infrared sensor assembly
A9	235-566	1	Audio amplifier module
A10	235-544	1	Audio/video, input/output module
A11	235-514	1	Magnet assembly
A12	235-558	1	Yoke assembly
A13	235-426	1	Remote control transmitter
	235-577	1	Remote control label (supplied with remote control)
A14	235-443	1	Isolation and adapter assembly
A15	235-449	1	Antenna balun assembly

CABLE ASSEMBLIES

NOTE: A cable marked 2C5/5A2 means that the cable has two connectors, both connectors marked with this number/letter combination. A cable marked "3O3-9M-9Q" means that the cable has three connectors, one marked "3O3," another marked "9M," and another marked "9Q."

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
	235-570	1	3R8 cable
	235-568	1	8S3-6R3 cable
	235-571	1	2A cable
	235-572	1	2B cable
	235-370	1	Line cord
	235-434	1	2C5/5A2 cable
	235-435	1	1K/6M1 cable
	235-436	1	6K3/3E6 cable
	235-438	1	6G4/4M1 cable
	235-439	1	6Q2/2J6 cable
	235-440	1	1J6/6L1 cable
	235-441	1	6I2-2N6 cable
	235-447	1	6O9 cable w/round socket
	235-451	1	6H6 cable w/socket

KEY No.	HEATH Part No.	QTY.	DESCRIPTION

Cable Assemblies (cont'd.)

	235-452	1	6P2-2I6 cable
	235-516	1	4O3/3O3 cable
	235-518	1	4E8/8C4 cable
	235-519	1	8J4 flat cable w/four terminal connectors
	235-520	1	8B4 flat cable w/four terminal connectors
	235-522	1	8F4 cable
	235-527	1	6B6-6C6 cable
	235-528	1	6A6 cable
	235-533	1	4P9-4G4 cable
	235-534	1	4P2-P2 cable
	235-536	1	4N4-1N cable
B1	235-537	1	Cable and terminal assembly
	235-538	1	4M4-1M cable
	235-539	1	4D9-9R cable
	235-540	1	8G6-6J4 cable
	235-541	1	4Q3-9M-9Q cable
	235-542	1	4C4-4B4 cable
	235-543	1	6F9-6U9-8K6-4L4-9P-9N cable
B2	235-529	1	Jack and two 75 Ω cable assembly
B3	234-530	1	Jack and 75 Ω cable assembly
B4	235-453	1	Wire and terminal assembly
B5	235-532	1	Wire and terminal assembly w/plastic insulator
B6	235-477	1	8" 75 Ω cable w/plugs
B7	235-567	1	Jumper connector 3S8
B8	235-202	1	Shorting connector 9N 9P
B9	235-550	1	Degaussing coil w/connector 3T8

PLASTIC AND NYLON PARTS

C1	235-145	2	Small wire twist
C1	235-146	2	Medium wire twist
C1	235-350	3	Large wire twist
C2	235-404	1	Strain relief
C3	235-553	1	CRT mask
C4	235-554	1	Control escutcheon
C5	235-475	1	Mounting bracket
C6	235-531	3	Knob
C7	354-5	1	3-3/4" cable tie
C8	354-7	3	8" cable tie
C9	354-10	5	11-1/2" cable tie
C10	235-564	1	Infrared window
C11	235-466	1	Adapter mounting bracket
C12	261-43	1	Rubber bumper
C13	235-407	3	Round standoff
C14	235-485	3	Square standoff
C15	346-26	1	Plastic tubing
C16	490-1	1	Alignment tool
C17	490-5	1	Nut starter

KEY No.	HEATH Part No.	QTY.	DESCRIPTION

HARDWARE

NOTE: The hardware is shown full size so you can place any nut, screw, etc, you are uncertain about over the drawing. Also, the hardware may be packed in more than one envelope. Open all of the envelopes (marked HDW) before you check the hardware against the Parts List.

#2 & #4 Hardware

D1	235-489	2	M2.6 × 10 mm black phillips screw
D2	235-560	2	#4 × 5/16" black phillips screw
D3	250-1412	6	4-40 × 3/8" black phillips screw
D4	252-2	6	4-40 nut
D5	254-9	6	#4 lockwasher

#6 Hardware

E1	250-1264	2	6-32 × 3/8" hex head screw
E2	250-475	16	#6 × 3/8" hex head screw
E3	252-3	14	6-32 nut
E4	253-60	12	#6 flat washer
E5	254-1	4	#6 lockwasher
E6	259-1	1	#6 solder lug

#8 Hardware

F1	235-555	2	8-32 setscrew
F2	235-191	3	8-10 × 3/8" hex head screw
F3	250-1314	4	8-32 × 3/8" hex head screw
F4	235-190	23	8-10 × 1/2" hex head screw
F5	235-260	5	8-18 × 1/2" hex head screw w/washer
F6	235-261	10	8-15 × 3/4" hex head screw
F7	235-396	2	8-18 × 3/4" hex head screw w/washer
F8	252-4	4	8-32 nut
F9	254-2	4	#8 lockwasher
F10	235-557	2	#8 flat fiber washer

#10 Hardware

G1	250-330	4	10-32 × 3/8" screw
G2	235-561	4	10-32 × 1/2" hex head screw w/washer
G3	235-174	12	10-8 × 3/4" hex head screw
G4	252-5	4	10-32 nut
G5	254-3	4	#10 lockwasher
G6	259-5	1	#10 solder lug

Heathkit®

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Other Hardware				
H1	250-470	4	1/4-20 × 1-1/2" bolt	
H2	235-423	1	3/8" hex nut	
H3	253-31	4	3/4" flat washer	
H4	252-67	4	Self-retaining nut	
INSULATORS – SHIELDS – INLAYS				
J1	73-159	2	Rubber insulator	
J2	235-498	3	Rubber wedge	
J3	75-737	1	6" × 8" insulating paper	
J4	75-813	1	7" × 4-1/2" insulating paper	
J5	235-565	1	Insulating paper w/slots	
J6	235-502	8	Round light shield (includes one extra)	
J7	75-846	2	Side light shield	
J8	75-847	1	Top light shield	
J9	235-504	1	7" × 8-1/4" insulating paper w/tab	
J10	235-551	1	Door inlay (plain)	
J11	235-576	1	Door inlay (wood grain)	
J12	235-524	1	Keyboard membrane inlay	
METAL PARTS				
K1	200-1461	1	Chassis base	
K2	204-2509	1	I/O mounting bracket	
K3	204-2748	2	Mask mounting bracket	
K4	204-2730	1	Right support bracket	
K5	204-2755	1	Left support bracket	
K6	204-2756	2	Control bracket	
K7	235-495	1	Contact spring w/tabs	
K8	235-563	1	CRT contact spring	
K9	235-545	1	Sweep support bracket	
K10	235-546	1	Amplifier mounting bracket	
K11	235-547	1	"Z" mounting bracket	
K12	235-548	2	Corner mounting bracket	
K13	235-549	2	Corner mounting bracket	
K14	235-523	1	Control door	

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
TRANSFORMERS				
L1	235-216	1	Power transformer	TX301
L2	235-445	1	Transformer w/connectors 6T3-6S3	T1
L3	235-517	1	Transformer w/connectors 8A8-8T8	T2
MISCELLANEOUS				
M1	6-103-12	1	10 kΩ, 5% (brn-blk-org) resistor	Test
M1	1-37	1	2.2 MΩ, 1/2-watt, 10% (red-red-grn) resistor	RX301
M2	21-72	3	.005 μF ceramic capacitor	CX301, CX302, CX303
M3	45-611	1	Line choke	LX303
M4	235-161	2	2" speaker	
M5	235-552	2	5" × 7" speaker	
M6	260-53	3	Alligator clip	
M7	432-66	1	Push-on connector	
M8	235-515	3	Phono jack assembly	
	411-868	1	25VHFP22 CRT (Cathode Ray Tube)	V301
M9	421-3	1	2-ampere slow blow fuse	F301
M10	431-42	1	5-lug terminal strip	
M11	431-609	1	5-lug terminal strip w/fuse clips	
M12	235-562	1	Strain relief crimp	
M13	235-556	1	Audio/video panel	
	344-15	42"	Black stranded wire	
	346-1	3"	Fiber sleeving	
M14	490-210	1	Nut driver	

STEP-BY-STEP ASSEMBLY

CHASSIS ASSEMBLY

Refer to Pictorial 2-1 (Illustration Booklet, Page 7) for the following steps.

NOTES:

1. Place a soft towel, or a clean throw rug on your work surface to protect the finished surfaces as you perform the following steps.

2. In all of the assembly steps, "right," and "left" refers to the position as shown in the illustration without regard to the actual left or right of the chassis.

3. When you install assemblies with cables coming from them, unwrap and straighten the cables before you mount the assembly. Make sure there are no kinks in any of the wires.

( ) Place the CRT mask with the front facing down on your work surface and the ~~indicated tab at the top~~ as shown in the Pictorial. flat edges

NOTE: The term "hardware" will be used to refer to the screws, nuts, and lockwashers where parts are being mounted in some of the following steps. The phrase "6-32 × 3/8" black phillips hardware," for example, means to use a 6-32 × 3/8" black phillips screw, one or more #6 lockwashers, and a 6-32 nut. Refer to the Pictorial, or any Details that are used in the steps, for the correct number of lockwashers and the correct way to install the hardware.

( ) Mount corner mounting brackets to the mask with 10-8 × 3/4" hex head screws. Since there are two different pairs of mounting brackets, make sure to position the correct bracket on the mask so the mounting holes align as shown in the Pictorial.

WARNING: Due to the large surface area and high vacuum, handle the picture tube (CRT) with extreme care. Do NOT strike, scratch, or subject the CRT to more than moderate pressure at any time. Never lift the CRT by its neck. A fracture of the glass could result in an implosion of considerable violence capable of causing serious personal injury. When you handle the CRT, be careful not to touch the high voltage anode socket (see Pictorial 2-1 for its location), as you could receive a severe electrical shock.

IMPORTANT: Do not set the CRT down so that any part of its weight rests on the neck of the tube. If you must set the CRT down, always set it face down on a soft cloth until you install it.

( ) Carefully open the CRT carton by following the instructions printed on the outside of the carton. Discard any instructions packed inside the CRT carton. except warranty card

WARNING: The CRT may have a metal band around it, just behind the face. Do NOT attempt to remove the band; to do so could cause an implosion and possible personal injury.

( ) Carefully remove the CRT from its carton and check for a plastic film covering the face of the CRT. If there is such a film, remove and discard the film.

( ) Position the CRT with the anode socket towards the top of the CRT mask and place the CRT onto the four corner mounting brackets so the mounting holes align. Be careful not to bump the CRT neck when you work around it.

( ) Slide the CRT contact spring over the bottom right CRT bracket until the mounting holes align as shown. Make sure the contact spring fingers make solid contact with the painted side of the CRT. Bend the bracket as necessary.

( ) Mount the CRT to the corner mounting brackets with 10-32 × 1/2″ hex head screws w/washers. Make sure you center the CRT in the mask opening. Use your fingers to feel that the rounded edges are equal distances from the mask sides.

Refer to Detail 2-1A (Illustration Booklet, Page 7) for the following steps.

( ) Place the degaussing coil w/connector 3T8 over the CRT so that the degaussing coil is routed along the top of the CRT with the connector wires at the bottom right corner of the CRT. Make sure the wires are coming out of the coil form as shown and that the coil form is not twisted.

( ) Refer to inset drawing #1 on the Detail and wrap an 8″ cable tie around the left top corner mounting bracket and the degaussing coil and pull the cable tie tight. Cut off the excess cable tie, then melt the sharp edges of the cable tie down flat with your soldering iron. This will prevent a possible scratch when you are working around the CRT.

( ) Similarly wrap another 8″ cable tie around the top right corner mounting bracket and degaussing coil. Pull the degaussing coil tightly along the top of the CRT as you tighten the cable tie. Cut off the excess cable tie and melt the sharp end with your soldering iron.

( ) Refer to inset drawing #2 on the Detail and insert the pointed end of an 11-1/2″ cable tie into the slotted end of a second cable tie to make a 23″ cable tie. Insert the pointed end into the slot until the teeth catch in the second or third tooth.

( ) Similarly join two more 11-1/2″ cable ties.

( ) Loosely wrap one of the 23″ cable ties around the bottom left corner mounting bracket and the degaussing coil but do not pull it tight. Just start the end of the cable tie into the tie slot until the teeth catch.

( ) Loosely wrap the other 23″ cable tie around the bottom right CRT bracket and degaussing coil.

( ) Carefully center the degaussing coil above the lower left and right CRT corners as shown in the Pictorial, and then pull the two 23″ cable ties tight to hold it in place. Cut off the excess cable ties and melt the ends.

Refer to Pictorial 2-2 (Illustration Booklet, Page 8) for the following steps.

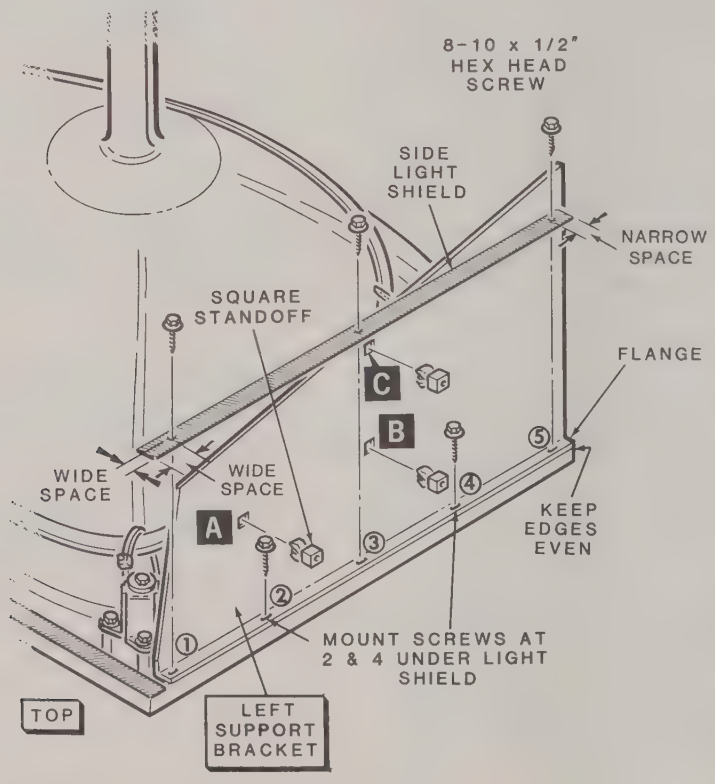
( ) Mount the top light shield and two mask mounting brackets to the top of the CRT mask at the two indicated locations with 8-10 × 1/2″ hex head screws. Position the shield with the wide side toward the outside of the mask. Make the screws just snug enough to hold the brackets in place and position them as shown. You will reposition them later.

Refer to Detail 2-2A for the following steps.

( ) Position the left support bracket with the flange on your work surface and press square standoffs into holes A, B, and C from the outside of the bracket.

( ) Mount the left support bracket to the left side of the CRT mask at holes 2 and 4 with 8-10 × 1/2″ hex head screws. Keep the bottom edge of the bracket even with the bottom edge of the mask.

( ) Mount a side light shield over the left side bracket flange at holes 1, 3, and 5 with 8-10 × 1/2″ hex head screws. Position the narrow and wide spaces of the light shield as shown in the Detail.



Detail 2-2A

Refer to Detail 2-2B for the following steps.

( ) Mount the right support bracket to the right side of the CRT mask at holes 2 and 4 with 8-10 × 1/2″ hex head screws. Keep the bottom edge of the bracket even with the bottom edge of the mask.

( ) Mount a side light shield over the right side bracket flange at holes 1, 3, and 5 with 8-10 × 1/2″ hex head screws. Position the narrow and wide spaces of the light shield as shown in the Detail.

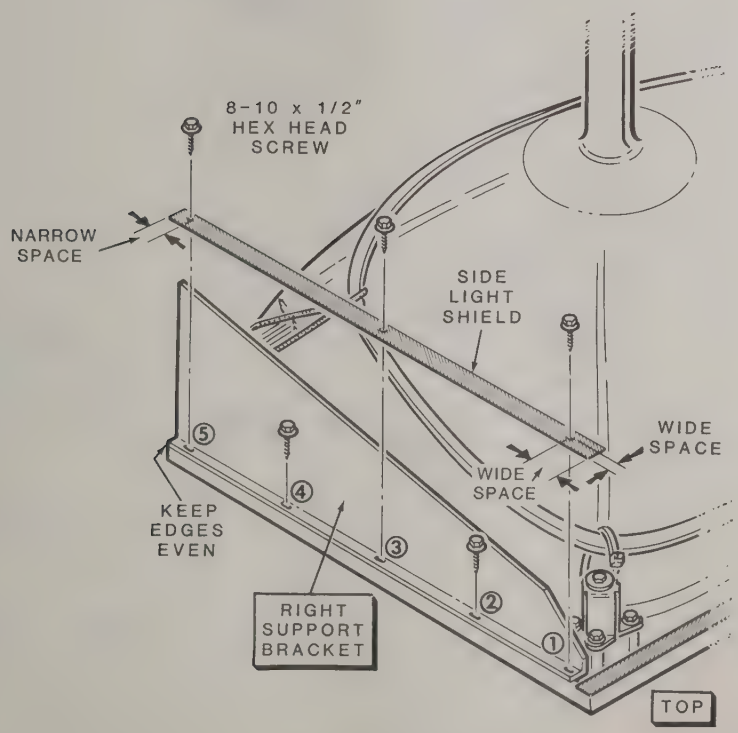
( ) Refer to Pictorial 2-2 and position the chassis base as shown and mount it to the support brackets with seven #6 × 3/8″ hex head screws. Mount a #6 solder lug at the indicated left support bracket hole and position it as shown. Do not overtighten the screws.

( ) Refer to the inset drawing on the Pictorial and install a self-retaining nut at one of the square chassis base flange holes.

( ) Similarly install the remaining three self-retaining nuts at the other three square chassis-base flange holes.

( ) Press round standoffs from the top of the chassis into chassis base holes D, E, and F.

( ) T1: Mount the transformer w/connectors 6T3-6S3 to the chassis base at G and H with #6 × 3/8″ hex head screws. Position the transformer with the leads as shown.



Detail 2-2B

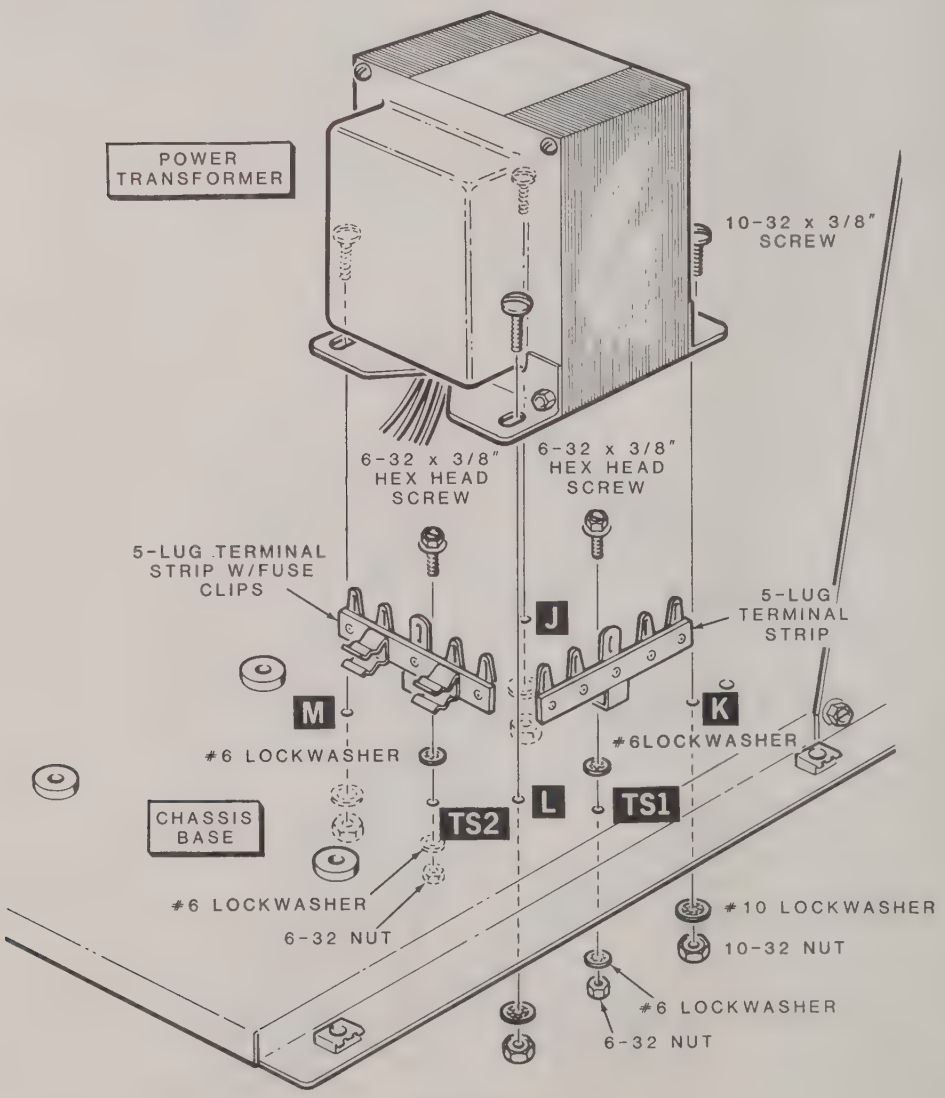
Refer to Detail 2-2C for the following steps.

( ) TX301: Mount the power transformer to the chassis base at J, K, L, and M with 10-32 × 3/8″ hardware. Position the transformer with the leads as shown.

NOTE: Use the plastic nut starter to hold and start 6-32 and 4-40 nuts on screws.

( ) Mount the 5-lug terminal strip to the chassis base at TS1 with 6-32 × 3/8″ hardware. Use two lockwashers at the terminal strip location. Position the terminal strip and lockwashers as shown.

( ) Mount the 5-lug terminal strip w/fuse clips to the chassis base at TS2 with 6-32 × 3/8″ hardware. Use two lockwashers at the terminal strip location. Position the terminal strip and lockwashers as shown.



Detail 2-2C

Refer to Pictorial 2-3 (Illustration Booklet, Page 9) for the following steps.

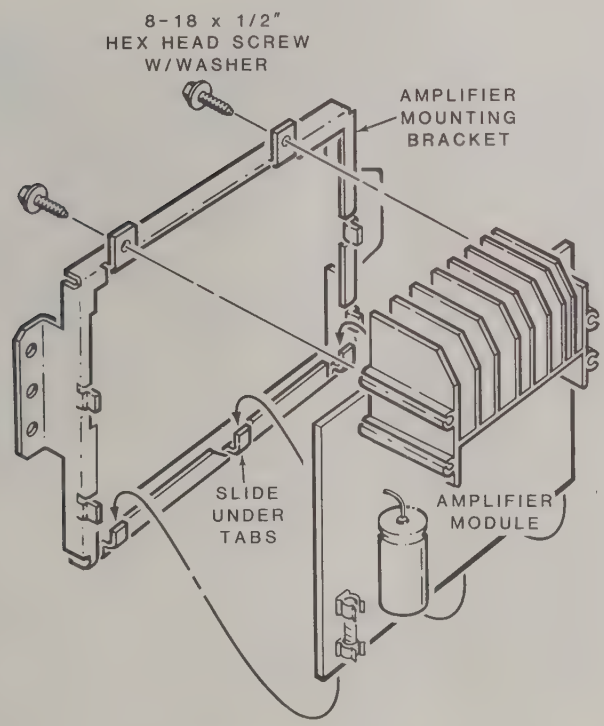
( ) Mount the "Z" bracket to the chassis with #6 × 3/8" hex head screws.

( ) Refer to Detail 2-3A, position the audio amplifier module and amplifier mounting bracket as shown, and mount the module under the three bracket tabs and to the amplifier heat sink with 8-18 × 1/2" hex head screws w/washers.

( ) Insert the amplifier mounting bracket tab into the "Z" bracket slot and mount the audio amplifier bracket assembly to the chassis with #6 × 3/8" hex head screws.

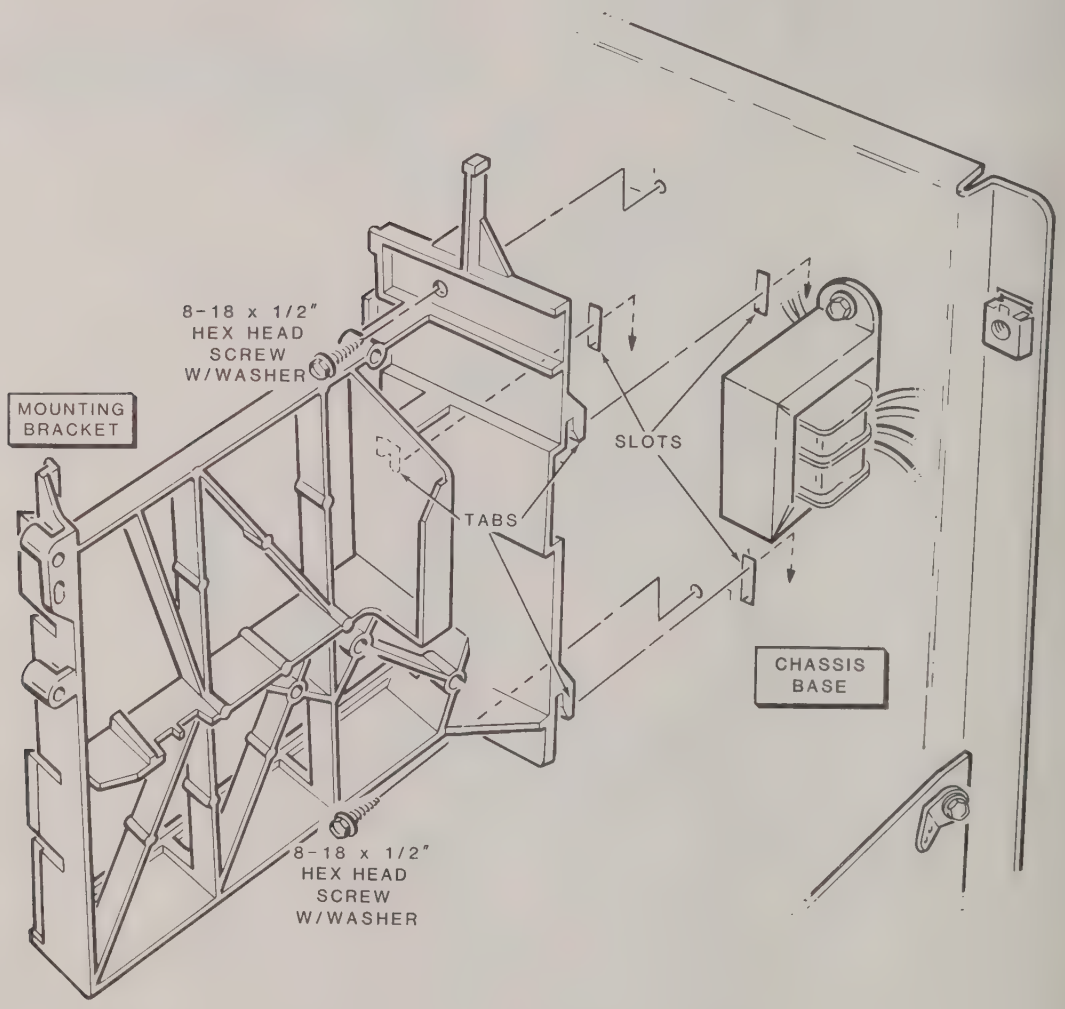
( ) Mount the audio/video input/output module to square standoffs B, and C with 8-15 × 3/4" hex head screws.

( ) Mount the I/O mounting bracket with a #6 × 3/8" hex head screw at the left support bracket hole next to square standoff A. Position the module tab between the bracket and the square standoff as shown.



Detail 2-3A

( ) Refer to Detail 2-3B and mount the mounting bracket to the chassis base by inserting the three tabs into chassis slots and pushing downward on the bracket until the tabs lock into place and the mounting hole aligns. Then secure the bracket to the chassis base with 8-18 × 1/2" hex head screws w/washers.



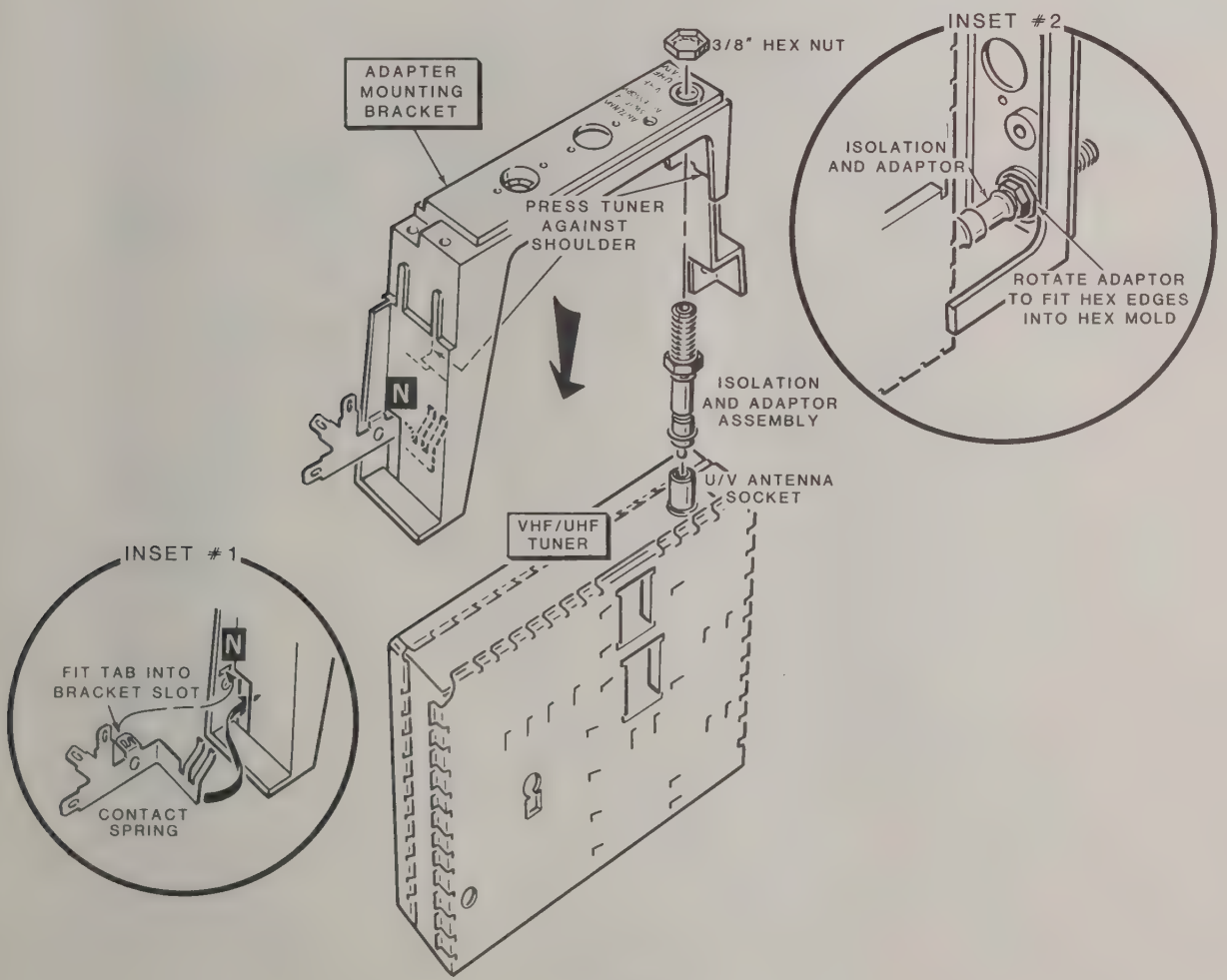
Detail 2-3B

Refer to Detail 2-3C for the following steps.

( ) Position the adapter mounting bracket as shown. Position the contact spring with tabs into the slot at N as shown in inset drawing #1 of the Detail so the tab fits into the bracket slot and the mounting holes align.

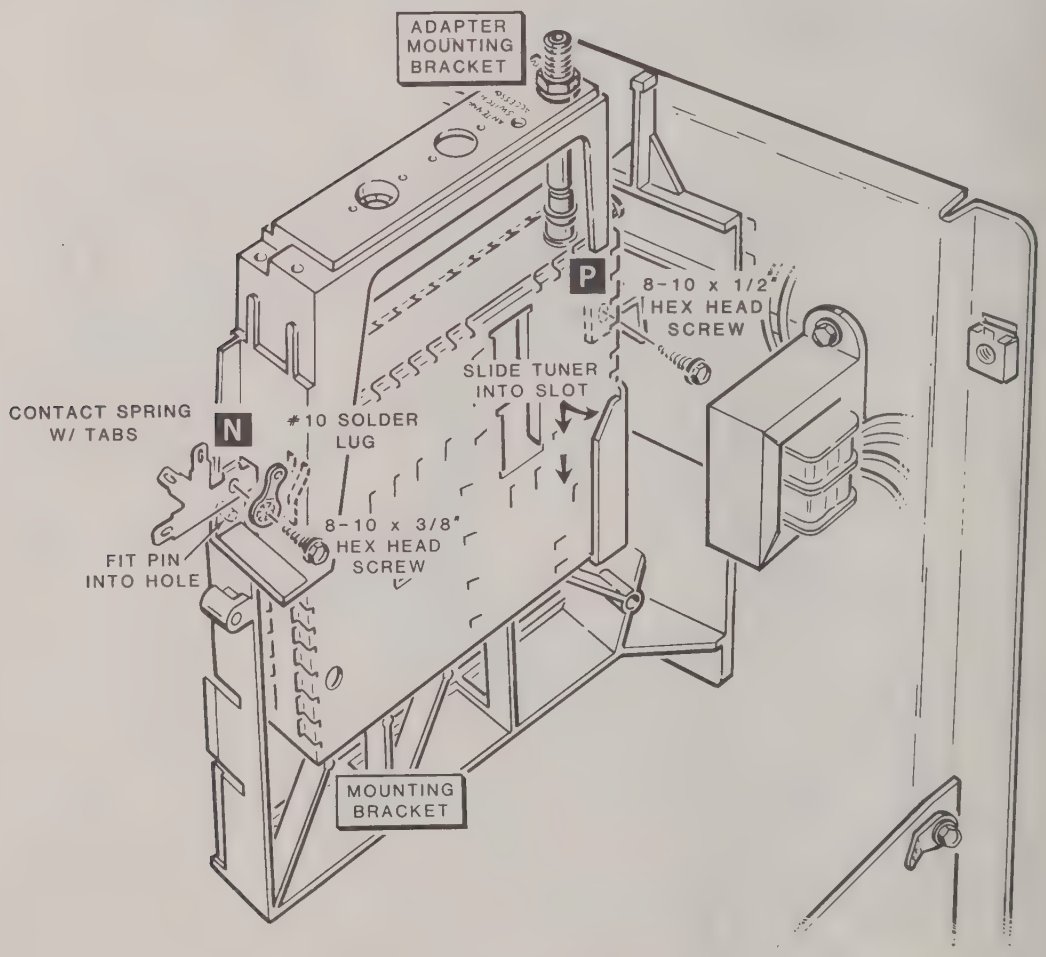
( ) Position the VHF/UHF tuner as shown. Then slide the phono plug end of the isolation and adapter assembly into the "U-V ANT" socket.

( ) Slide the VHF/UHF tuner into the adapter mounting bracket until the tuner is against the top and bottom shoulders of the bracket as shown. This is a tight fit so a moderate amount of force will be necessary to fit the tuner properly in place. Make sure the contact spring remains in place. When the tuner is in place, rotate and pull the isolation and adapter as necessary so the hex edges fit into the hex mold inside of the bracket as shown in inset drawing #2. Then secure the isolation and adapter assembly to the bracket with the 3/8" hex nut. Do not overtighten the nut and position it with the open side out.



Detail 2-3C

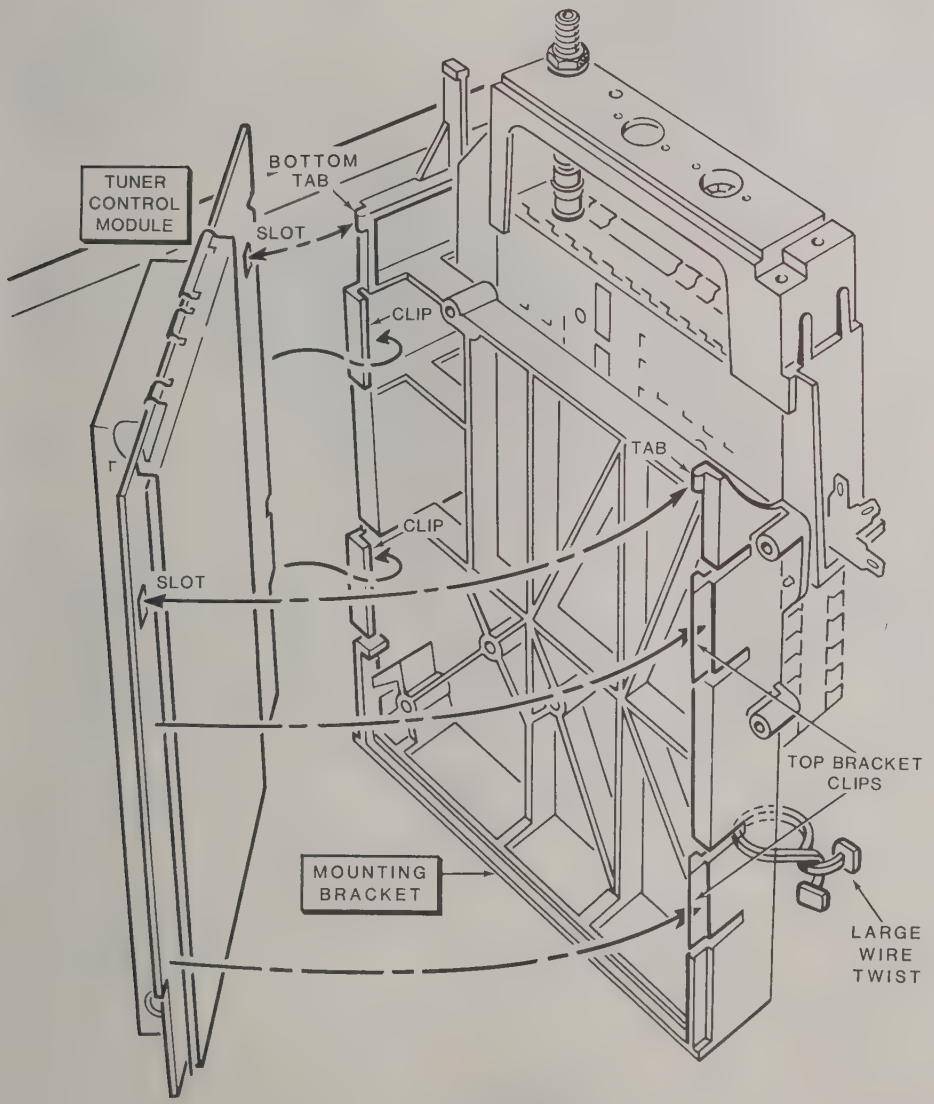
( ) Refer to Detail 2-3D and slide the VHF/UHF tuner into the mounting bracket. Position the adapter mounting bracket so the pin fits into the mounting bracket hole. Then install a 8-10 × 3/8″ hex head screw and a #10 solder lug at N and a 8-10 × 1/2″ hex head screw at P. Position the #10 solder lug as shown; do not overtighten the screws.



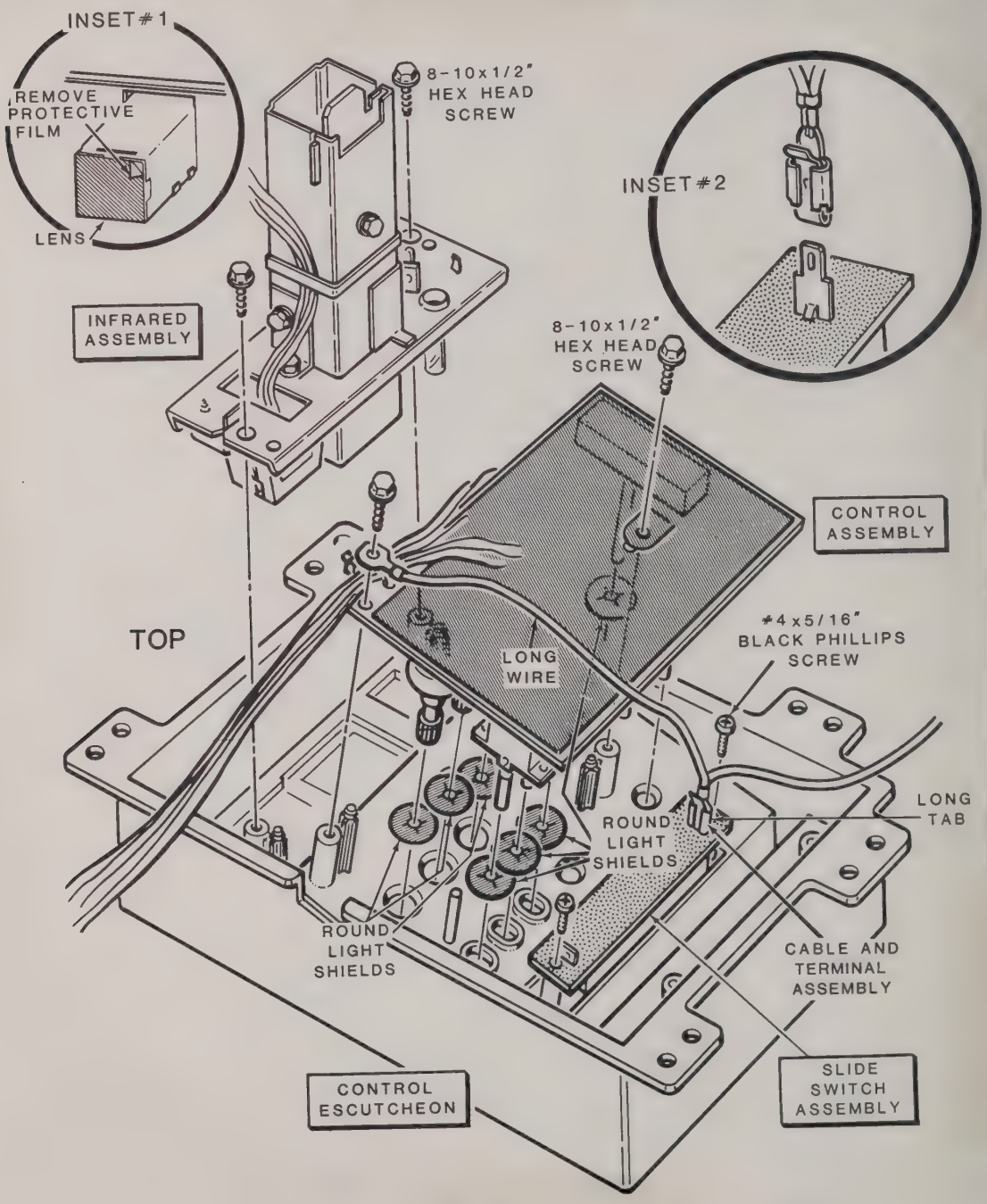
Detail 2-3D

[ ] Refer to Detail 2-3E and install a large wire twist through the slot in the mounting bracket and twist it once to hold it in place.

[ ] Refer to Pictorial 2-3 and Detail 2-3E and install the tuner control module into the mounting bracket as shown. Install the circuit board into the bottom tab first, then rotate the board until it is under the two bottom clips, and raise up on the top bracket clips with your thumb and snap the circuit board into place.



Detail 2-3E


INSET#1
REMOVE PROTECTIVE FILM
LENS
8-10x1/2" HEX HEAD SCREW
INFRARED ASSEMBLY
INSET#2
8-10x1/2" HEX HEAD SCREW
CONTROL ASSEMBLY
TOP
LONG WIRE
#4x5/16" BLACK PHILLIPS SCREW
LONG TAB
ROUND LIGHT SHIELDS
ROUND LIGHT SHIELDS
CABLE AND TERMINAL ASSEMBLY
CONTROL ESCUTCHEON
SLIDE SWITCH ASSEMBLY

Detail 2-4A

Refer to Pictorial 2-4 (Illustration Booklet, Page 9) for the following steps.

( ) Place the chassis in its upright position with the back facing you.

NOTE: The left side panel holes at Q and R are used for the Modern Cabinet and the holes at S and T are used for the Classic Cabinet. Use the pair of holes that match the type of cabinet you have purchased.

( ) Position a control bracket as shown and mount the bracket to the left side panel at hole Q or S with a #6 × 3/8" hex head screw. Keep the bracket parallel with the left edge of the CRT mask.

( ) Similarly, position a second control bracket as shown and mount the bracket to the left side panel at hole R or T with a #6 × 3/8" hex head screw.

Refer to Detail 2-4A for the following steps.

( ) Position the control escutcheon as shown.

( ) Refer to inset drawing #1 and remove the protective film from the lens of the infrared sensor. Then position the assembly as shown and mount it to the control escutcheon with 8-10 × 1/2" hex head screws.

( ) Position the slide switch assembly with the long tab as shown. Then mount the assembly to the escutcheon with #4 × 5/16" black phillips screws.

( ) Slide a round light shield over each of the four control assembly switches until it is against the switch body.

( ) Slide round light shields over the COLOR LEVEL, TINT, and SHARPNESS control shafts until they are against the control bodies.

( ) Locate the cable and terminal assembly. Mount the control assembly to the control escutcheon with 8-10 × 1/2" hex head screws and install the eyelet at the end of the longest wire at the indicated screw location.

( ) Install the terminal end of the cable and terminal assembly over the lug on the slide switch assembly. Press in on the terminal's tab as you install it over the lug as shown in inset drawing #2 on the Detail.

Refer to Detail 2-4B for the following steps.

( ) Carefully remove any dust from the infrared sensor window. Then remove the paper backing from the window and carefully center it over the top cutout of the control escutcheon. Press the window into place.

NOTE: In the following steps, use care when you install the decorative inlays. Once an inlay is installed, it is impossible to remove without destroying it. Make sure you install it correctly the first time.

( ) Position the control door as shown. Then remove the backing from the keyboard membrane inlay and very carefully align its left edge with the left edge inside the recessed area of the control door. Press the inlay against the control door from left-to-right.

NOTE: In the next step, use the wood grain door inlay label for the Classic Cabinet and the plain inlay label for the Modern Cabinet.

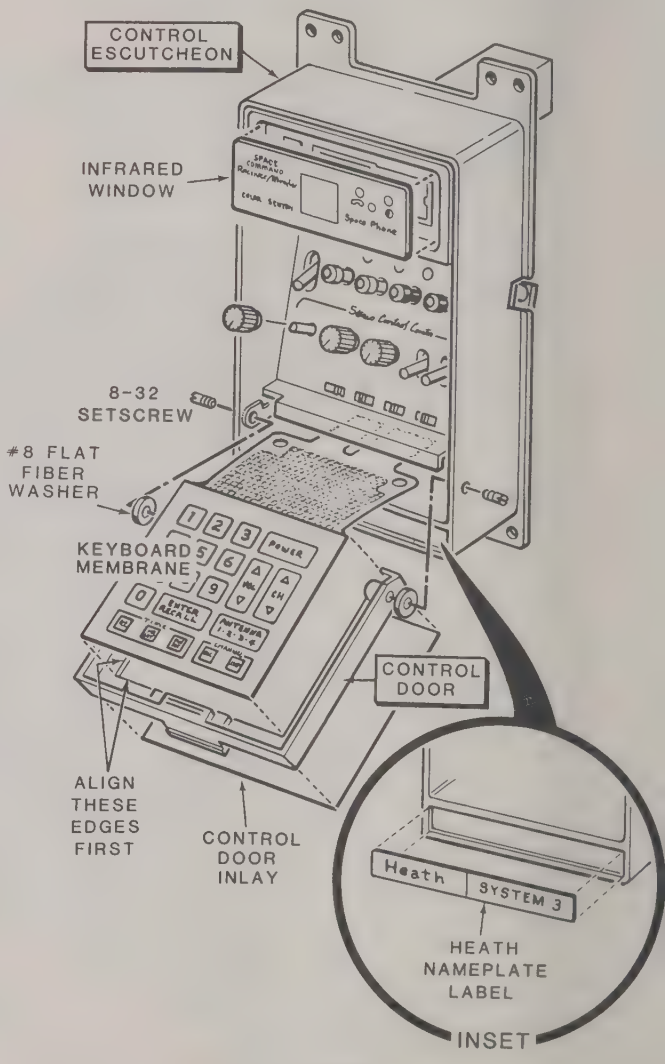
( ) Remove the backing from the appropriate control door inlay and carefully align its bottom edge with the bottom edge inside the recessed area of the control door. Then press the inlay against the front of the door from bottom to top.

NOTE: Check your control door to see if there are #8 flat fiber washers installed at the locations shown in the Detail. If there are, disregard their installation in the next step. Then discard the two #8 flat fiber washers in your parts.

( ) Insert the ribbon cables coming from the keyboard membrane through the slot at the bottom of the control escutcheon. Then insert the control door into place so that the mounting holes align and mount the door to the escutcheon with #8 flat fiber washers and 8-32 setscrews. Turn the setscrews until they are flush with the outside edge of the escutcheon.

( ) Remove the backing from the Heath nameplate label and press the label into the recessed area of the control escutcheon.

( ) Install knobs on the BALANCE, TREBLE, AND BASS control shafts. Line up the flat of the shaft with the knob flat and press the knobs onto the shafts as far as they will go.



Detail 2-4B

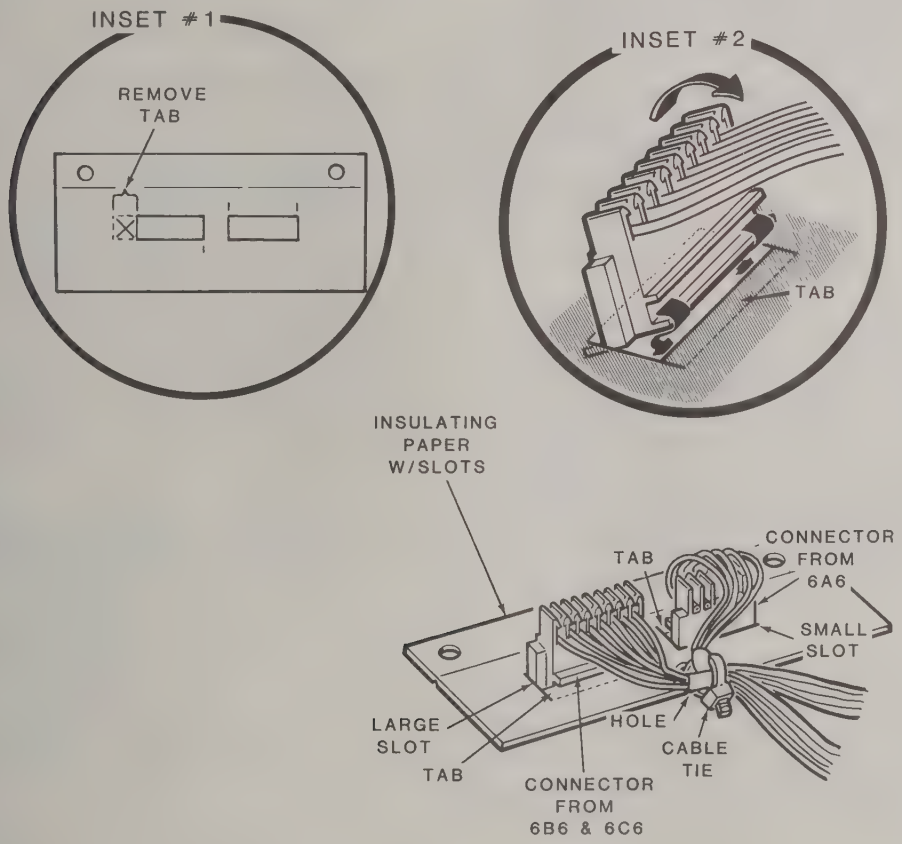
Refer to Detail 2-4C for the following steps.

( ) Refer to inset drawing #1 of the Detail and remove the indicated tab (if present) from the insulating paper w/slots.

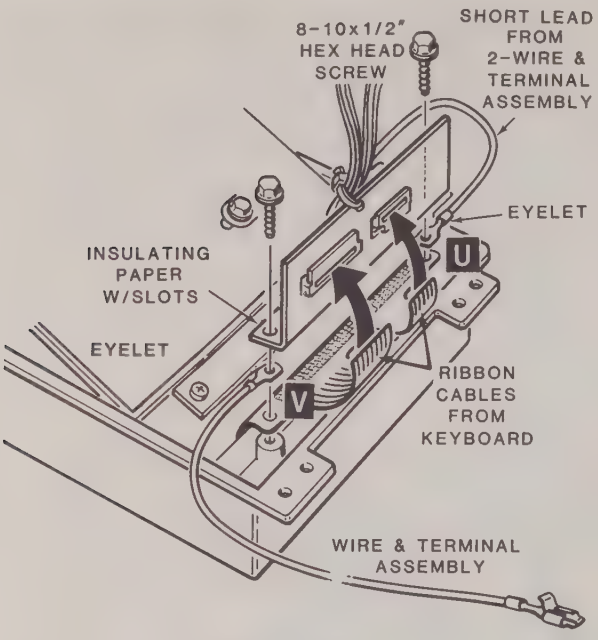
( ) Position the insulating paper w/slots as shown. Then insert the slotted connector at the opposite end of cables 6B6 and 6C6 into the large slot of the insulating paper with the tab as shown. Insert the connector into the slot as shown in inset drawing #2 of the Detail.

( ) Insert the slotted connector at the opposite end of cable 6A6 into the small slot of the insulating paper with the tab as shown. *Note that the connector wires are reversed from the previously installed connector wires.*

( ) Install a 3-3/4" cable tie around the cables and through the insulating paper hole. Cut off the excess cable tie.



Detail 2-4C



Detail 2-4D

( ) Refer to Detail 2-4D and form the insulating paper w/slots as shown. Then insert the wide and narrow ribbon cables coming from the keyboard membrane into the large and small slotted connectors as shown. Then mount the insulating paper and the free eyelet end of the 2-wire and terminal assembly to control escutcheon mounting hole U with a 8-10 × 1/2" hex head screw. Install the eyelet on the end of the wire under the insulating paper as shown.

( ) Refer to Detail 2-4D and locate the wire and terminal assembly. Then insert the eyelet on the end of the assembly under the insulating paper w/slots at mounting hole V. Mount the assembly with a 8-10 × 1/2" hex head screw. You will install the terminal end of this wire later.

( ) Refer to Pictorial 2-4 and loosely mount the control escutcheon assembly to the control brackets with 8-32 × 3/8" hex head hardware at the indicated outside holes. You will tighten the hardware later. NOTE: You may have to loosen the control brackets slightly to line up the mounting holes.

CHASSIS WIRING

Refer to Pictorial 2-5 (Illustration Booklet, Page 10) for the following steps.

NOTE: In the following steps, (NS) means not to solder because other wires will be added later. "S-" with a number following it, such as (S-3), means to solder the connection. The number tells you how many wires and/or leads are in the connection.

Connect the power transformer leads as follows. Make the lead connections mechanically secure as shown in inset drawing #1.

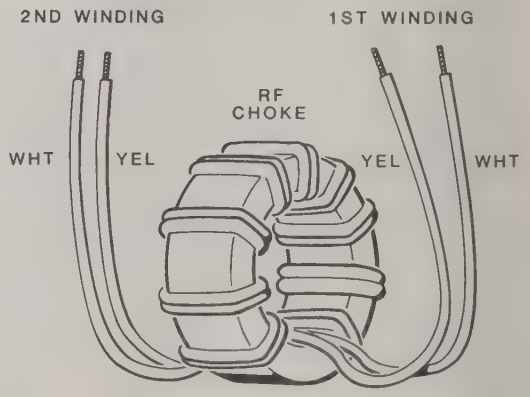
( ) Black lead to terminal strip TS1 lug 5 (NS).

( ) Black-yellow lead to terminal strip TS1 lug 4 (NS).

( ) Gray-brown lead to terminal strip TS2 lug 5 (NS).

( ) Gray lead to terminal strip TS2 lug 2 (S-1).

( ) Route the leads as shown and press them against the chassis base.



Detail 2-5A

Refer to Detail 2-5A and note that there are two sets of yellow and white windings on the RF choke. Make sure you connect the wires from the same windings in the following steps. Make the connections mechanically secure as before.

( ) Either yellow wire at terminal strip TS1 lug 2 (NS).

( ) White wire from the same winding at terminal strip TS1 lug 1 (NS).

( ) Remaining white wire at terminal strip TS2 lug 5 (NS).

( ) Remaining yellow wire at terminal strip TS2 lug 1 (NS).

NOTE: Make the following component lead connections mechanically secure.

( ) RX301: Connect one lead of a 2.2 MΩ, 1/2-watt, 10% (red-red-grn) resistor to terminal strip TS1 lug 1 (NS) and the other lead to lug 3 (S-1).

( ) Cut the leads of the three .005 μF ceramic capacitors to 5/8".

( ) CX301: Connect one lead of a .005 μF ceramic capacitor to terminal strip TS1 lug 4 (NS) and the other lead to lug 5 (NS).

( ) Cut four 1/4" pieces of fiber sleeving.

( ) CX302: Slide a 1/4" piece of fiber sleeving over each lead of a .005 μF ceramic capacitor. Connect one lead of the capacitor to terminal strip TS2 lug 3 (NS) and the other lead to lug 5 (NS).

( ) CX303: Slide a 1/4" piece of fiber sleeving over each lead of another .005 μF ceramic capacitor. Connect one lead of the capacitor to terminal strip TS2 lug 1 (NS) and the other lead to lug 3 (S-2).

— separate line cord ends

NOTE: When you connect the following cables, make the connections mechanically secure.

( ) Connect the ribbed or marked lead coming from pin 3 of cable connector 3R8 to terminal strip TS1 lug 4 (S-3) and the smooth lead coming from pin 1 to lug 5 (S-3). Make sure you solder all of the leads at the terminal strip lugs.

( ) Connect the ribbed or marked lead of the line cord to terminal strip TS1 lug 1 (S-3) and the smooth lead to lug 2 (S-2).

Connect the three leads from cable 8S3-6R3 to terminal strip TS2 as follows. Make the connections mechanically secure.

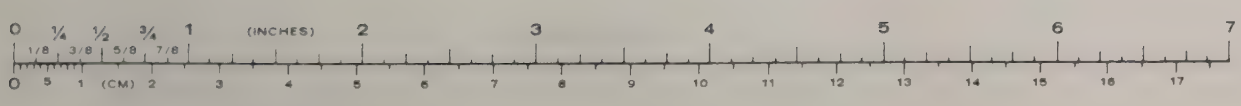
( ) Black lead to lug 1 (S-3).

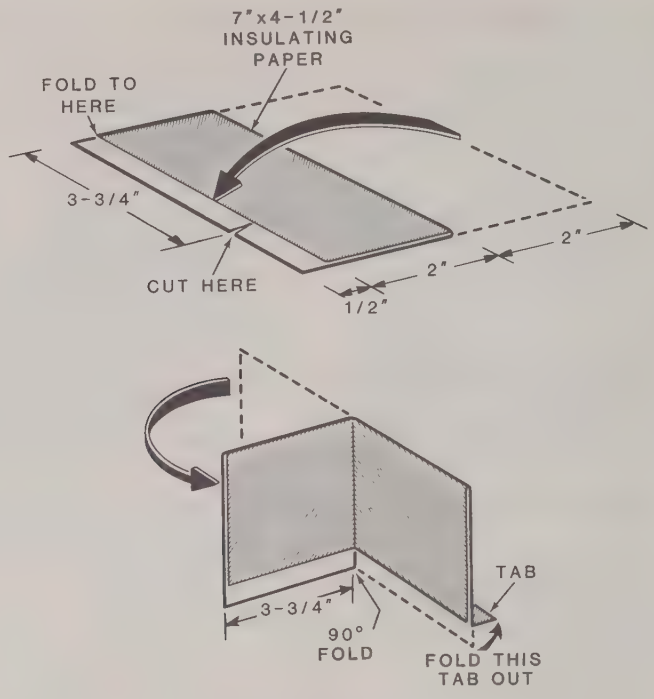
( ) Violet lead to lug 4 (S-1).

( ) Gray lead to lug 5 (S-4).

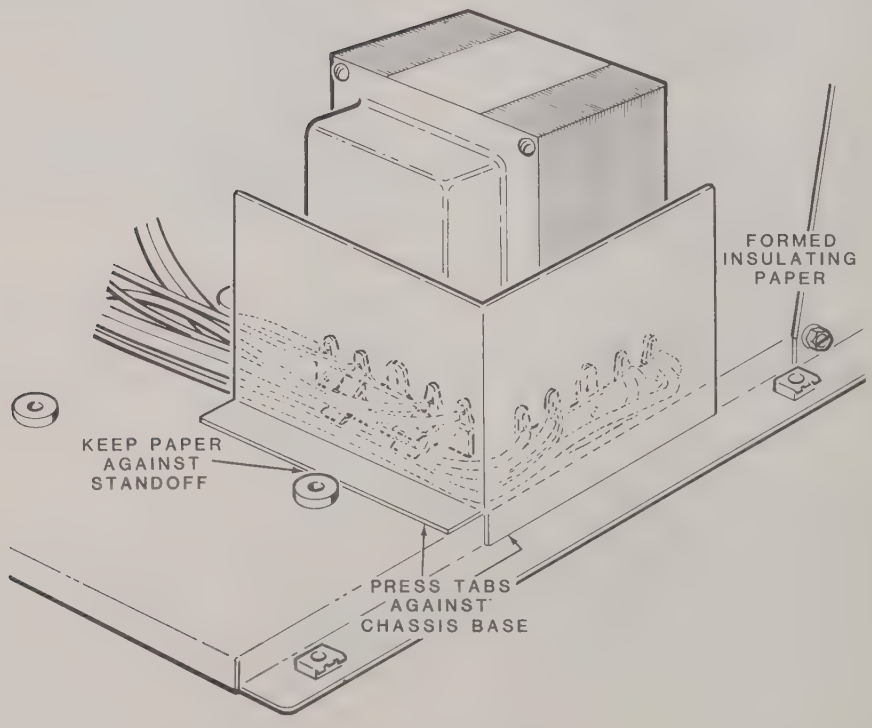
( ) FX301: Refer to inset drawing #2 and install the 2-ampere slow-blow fuse into the fuse clips of terminal strip TS2.

( ) Recheck the connections at the terminal strip lugs and make sure that all of the leads are securely soldered and that none are loose.





Detail 2-5B



Detail 2-5C

( ) Refer to Detail 2-5B and form the 7" × 4-1/2" piece of insulating paper as follows.

1. Position the paper with the dimensions as shown and the paper backing facing up. Then bend the insulating paper over until the edge of the top fold is 1/2" from the edge of the bottom fold. Crease the paper at the fold.

2. Make a cut at the 3-3/4" location to make two tabs.

3. Bend and crease the indicated tab in the direction shown.

4. Unfold the insulating paper and remove the paper backing from the adhesive side. Then carefully refold the two sections together, keeping the side edges even.

5. Bend the paper 90° at the 3-3/4" cut.

( ) Refer to Detail 2-5C and press the adhesive tabs of the formed insulating paper against the chassis base around the power supply as shown. Keep the indicated edge of the paper against the plastic standoff. Dress the leads as shown in the Detail.

Refer to Pictorial 2-6 (Illustration Booklet, Page 11) for the following steps.

NOTE: Whenever you install each of the following labels, first remove the paper backing from the label and then press the label at the location indicated in the steps and the Pictorial.

( ) Write the following information on a fuse replacement label (#390-1255):

"2-ampere, 3AG, slow-blow"

( ) Press the 2-ampere fuse replacement label against the tab of the formed insulating paper of the power supply assembly.

( ) Write ".6-ampere, 3AG, slow-blow" on another fuse replacement label.

( ) Remove the paper backing and press the .6-ampere fuse replacement label next to the audio amplifier fuse on the outside of the left side panel.

( ) Press a manufacturing date label and the blue and white label on the chassis base just inside the right edge. NOTE: Refer to the numbers on the blue and white label in any correspondence you have with the Heath Company concerning your TV Set.

( ) Press the X-Ray warning label on the outside of the right support bracket at the indicated locations.

( ) Press the ground label on the inside of the right support bracket as shown.

( ) Press the .187-ampere fuse replacement label on the chassis base under the VHF/UHF tuner.

( ) Press the volume caution label on the inside of the left support bracket.

( ) Press the general fuse replacement label on the top side of the adapter mounting bracket.

Refer to Pictorial 2-7 (Illustration Booklet, Page 12) for the following steps.

( ) Locate the male connector assembly you assembled and set aside earlier.

( ) Position the main module on your work surface as shown in the Pictorial. However, position it aside from the main unit at this time. You will place it on the chassis base after you wire it in the following steps.

Connect the free wire ends coming from the male connector to the main module as follows. When you make a connection, form a hook in the bare wire end, and then crimp and solder the wire to the indicated point on the main module. Raise the indicated lead off the board if necessary but be careful not to put too much stress on the component or you may break it. Use only enough heat to make a good solder connection

( ) Yellow wire coming from hole 1 to the indicated lead of resistor R2276 (gry-red-brn-gld).

( ) Green wire coming from hole 2 to the indicated lead of 1/2-watt resistor R2704 (red-blk-red-gld).

( ) Red wire coming from hole 3 to the indicated lead of resistor R3463 (gry-red-brn-gld).

( ) Black wire coming from hole 4 to wire W17.

( ) Blue wire coming from hole 5 to wire L2424.

( ) Violet wire coming from hole 6 to wire W52.

( ) Check the six wire connections and make sure they are properly soldered and are not touching any other component leads.

( ) Place the main module on the chassis base against the power transformer as shown in the Pictorial.

In the following steps, you will connect the individual cables and the ends of the cables coming from the assemblies. Most of the cables are identified by a number/letter combination (stamped on the connectors) that matches the number/letter combination next to the circuit board plug. However, some of the connectors or module plugs do not have any physical number/letter designation. These will be identified in the Pictorials. When you connect cable connectors, make sure the cable is routed as shown in the Pictorial. All of the connectors are polarized with grooves and notches or pins. Route all of the cables neatly and orderly so that you can easily identify them later.

( ) Connect the 2-hole connector coming from the infrared sensor assembly to the 2-hole connector coming from the control escutcheon assembly.

Install cable connectors coming from the control escutcheon assembly to the audio/video input/output module as follows.

( ) Connector 1S4 to plug 1S4.

( ) Connector 4H to plug 4H.

Refer to inset drawing #1 and install the cable connectors coming from the control escutcheon assembly to the audio amplifier module as follows:

( ) Connector 8D7 to plug 8D7.

( ) Connector 8H7 to plug 8H7.

( ) Connector 8E7 to plug 8E7.

Install the following control escutcheon assembly cable connectors to the main module.

( ) Connector 2A7 to plug 2A7.

( ) Connector 2B7 to plug 2B7.

( ) Install cable connector 6D6 coming from the slide switch assembly on the control escutcheon assembly to tuner control module plug 6D6.

Install cable connectors coming from the keyboard membrane ribbon cable sockets to the tuner control module as follows:

( ) Connector 6A6 to plug 6A6.

( ) Connector 6B6 to plug 6B6.

( ) Connector 6C6 to plug 6C6.

( ) Wrap the large wire twist, connected to the mounting bracket, around cables 6A6, 6B6, 6C6, 6D6, 2A7, and 2B7.

( ) Install the terminal on the free end of the black wire coming from the slide switch assembly mounting screw to the indicated tab on the contact spring w/tabs.

NOTE: If you intend to install the optional Space Phone Accessory, position cable connectors 9K, 9U, and 9V, coming from the control escutcheon assembly, back over the top of the CRT mask out of the way for now. If you do not intend to install the accessory, wrap them in with the cables in the following step.

( ) Refer to inset drawing #2 and gather the cables coming from the control escutcheon as-

semblies (except for the black wire coming from the slide switch assembly) into a bundle and wrap a large wire twist around them to hold them in place.

( ) Install the connectors on the transformer w/connectors 6T3 and 6S3 to tuner control module plugs 6T3 and 6S3. Route the leads as shown.

( ) Install connector 6R3 coming from the power supply to tuner control module plug 6R3 and connector 8S3 to amplifier module plug 8S3.

( ) Install cable connector 3T8 on the end of the degaussing coil to main module plug 3T8.

( ) Install cable connector 3R8 coming from the power supply to main module plug 3R8.

Refer to Pictorial 2-8 (Illustration Booklet, Page 13) for the following steps.

( ) Connect the unmarked connector on the end of cable 6H6 to the infrared sensor assembly circuit board with the white wire as shown. Install connector 6H6 to tuner control module plug 6H6.

NOTE: When you make connections to the bottom row of pins on the tuner control module, the connections will be somewhat more difficult than usual because of the confined space. Take your time when you install a connector and make sure the plastic pins fit into the circuit board holes properly.

( ) Install one connector on cable 6G4/4M1 to the tuner control module plug 6G4 and the other end to the main module plug 4M1.

( ) Install connector 6J4 on cable 8G6-6J4 to the tuner control module plug 6J4 (next to pin P3 which is not used) and connector 8G6 to amplifier module plug 8G6.

( ) Install connector 6O9 on cable "6O9 and socket" to the tuner control module plug 6O9. Connect the socket to the adapter mounting bracket with M2.6 × 10 mm black phillips head screws. Route the cable as shown.

( ) Install connector 6P2 on cable 6P2-2I6 to the tuner control module plug 6P2 (next to plug 6N9 which is not used) and connector 2I6 to main module plug 2I6.

( ) Install one connector on cable 6K3/3E6 to tuner control module plug 6K3 and the other connector to main module plug 3E6.

NOTE: Refer to inset drawing #1 for the next two steps.

( ) Install one connector on cable 1K/6M1 to tuner control module plug 6M1 and the other connector to VHF/UHF tuner plug 1L1/1K6.

( ) Install one connector on cable 1J6/6L1 to tuner control module plug 6L1 and the other connector to VHF/UHF tuner plug 1J6.

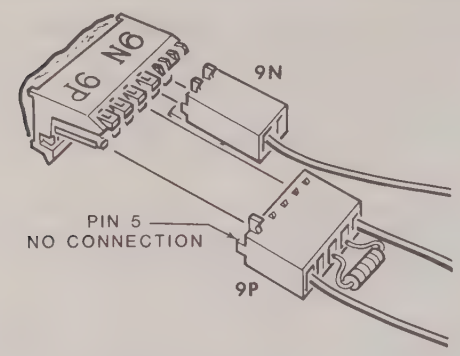
( ) Install connector 6I2 on cable 6I2-2N6 to the tuner control module plug 6I2 and connector 2N6 to the main circuit board module plug 2N6.

Install connectors on the 6F9-4L4-6U9-9P-9N-8K6 cable as follows:

( ) Connector 8K6 to amplifier module plug 8K6.

( ) Connector 6F9 to the tuner control module 6F9.

( ) Connector 4L4 to main module plug 4L4.



Detail 2-8A

NOTE: If you intend to install the Space Phone Accessory, skip the following step.

( ) Refer to Detail 2-8A and install the 9P and 9N cable connectors to the "9N 9P" shorting connector as shown.

NOTE: You will install connector 6U9 later.

( ) Install connector 4D9 on cable 4D9-9R to audio/video input/output module plug 4D9. Leave the other end loose.

( ) Install connector 4P9 on the 4G4-4P9 cable to main module plug 4P9 and connector 4G4 to audio/video input/output module plug 4G4.

( ) Install connector 4P2 on cable 4P2-P2 to audio/video input/output module plug 4P2 and connector P2 to main module plug 4P2.

( ) Install connector 4M4 on cable 4M4-1M to audio/video input/output module plug 4M4 and connector 1M to main module plug 1M. NOTE: If there is a shorting socket at plug 1M, remove and discard the plug, and then install the connector.

( ) Install connector 4N4 on cable 4N4-1N to audio/video input/output module plug 4N4 and connector 1N to main module plug 1N. NOTE: If there is a shorting socket at plug 1N, remove and discard the plug, and then install the connector.

( ) Install connector 4E8 on cable 4E8-8C4 to audio/video input/output module plug 4E8 and connector 8C4 to amplifier module plug 8C4.

( ) Install connector 4Q3 on cable 4Q3-9M-9Q to audio/video input/output module plug 4Q3. Leave 9M and 9Q loose. Make sure you use plug 4Q3, not 4O3.

NOTE: If you intend to install the Space Phone accessory, skip the next step, otherwise, perform the step.

( ) Refer to inset #2 and bundle cables 6U9, 9Q, 9R, 9N-9P, and 9M into a bundle and wrap a medium wire twist around them to hold them together.

( ) Install one of the connectors on cable 6Q2/2J6 to tuner control module plug 6Q2 and the other connector to main module plug 2J6.

( ) Install jumper connector 3S8 to the main module plug 3S8.

( ) Install one of the connectors on cable 3O3/4O3 to main module plug 3O3 and the other connector to audio/video, input/output module plug 4O3.

( ) Install connector 4B4 on cable 4B4-4C4 to the main module plug 4B4 and connector 4C4 to the audio/video input/output module plug 4C4.

Refer to Detail 2-8B for the following five steps.

( ) Connect one end of the 8" 75 Ω coaxial cable w/plugs to the PRE OUT jack on the VHF/UHF tuner and the other end to the indicated jack on the tuner control module.

( ) Mount the "jack and 75 Ω cable assembly" (1st assembly) to the adapter mounting bracket with an 8-10 × 1/2" hex head screw.

( ) Mount the "jack and two 75 Ω cable" assembly (2nd assembly) to the adapter mounting bracket with an 8" cable tie. Position the mounting tab as shown and cut off the excess cable tie.

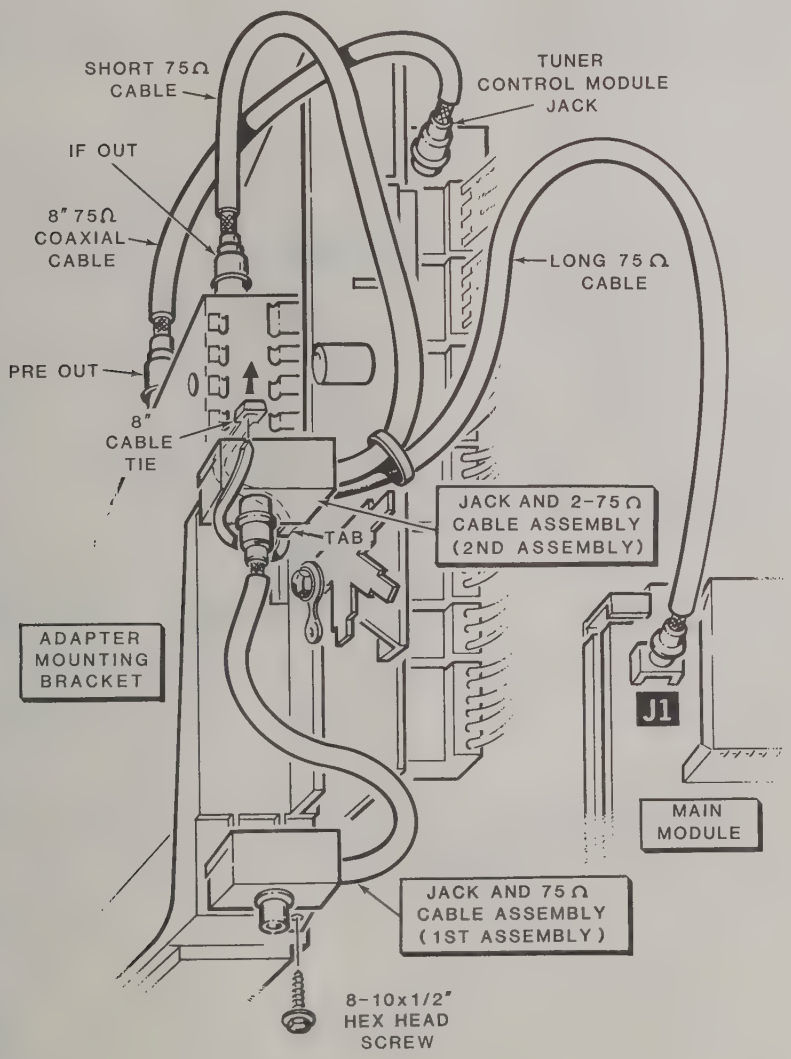
( ) Plug the 75 Ω cable coming from the first assembly into the jack of the second assembly.

( ) Plug the short 75 Ω cable coming from the second assembly to the IF OUT jack on the VHF/UHF tuner and the long 75 Ω cable to J1 on the main module.

( ) Mount the crosshatch circuit board assembly to the adapter mounting bracket with 8-10 × 3/8″ hex head screws. Position the circuit board ~~as shown.~~ with component side positioned toward main module.

( ) Connect the female connector shell on the crosshatch circuit board to the male connector coming from the main module.

( ) Install the terminal with the plastic insulator, on the wire and terminal assembly, to the spark gap assembly on the main module. Connect the other terminal to the indicated tab on the contact spring w/tabs.



Detail 2-8B

Refer to Detail 2-8C for the following steps.

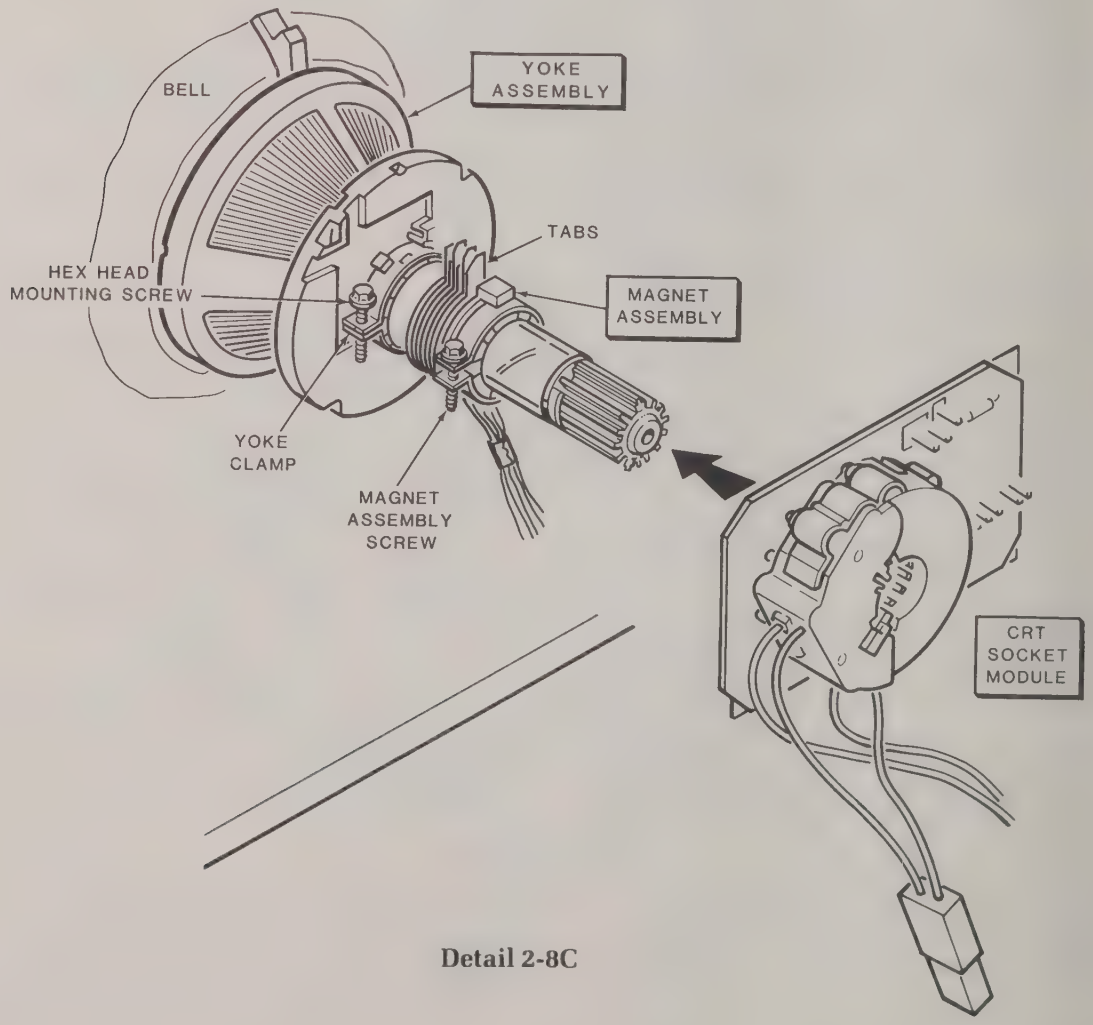
( ) Carefully slide the yoke over the neck of the CRT and position it against the bell of the CRT. Tighten the hex head mounting screw just enough to keep it from moving. The screw should be perpendicular to the bottom of the chassis as shown.

( ) Refer to inset drawing #3 on Pictorial 2-8 and carefully slide the magnet assembly over the neck of the CRT until it is 3" from the end of the neck as shown. Rotate all of the tabs to the top of the assembly with the mounting screw at the same position as the yoke mounting screw. Tighten the magnet assembly screw just enough to hold the assembly firmly in place.

( ) Install the CRT socket module over the end of the CRT until it is firmly seated in place.

Refer to Pictorial 2-9 (Illustration Booklet, Page 14) for the following steps.

( ) Refer to inset drawing #1 and install the connector on the ends of the two gray socket leads coming from the CRT socket module to the indicated tab of the CRT contact spring.



Detail 2-8C

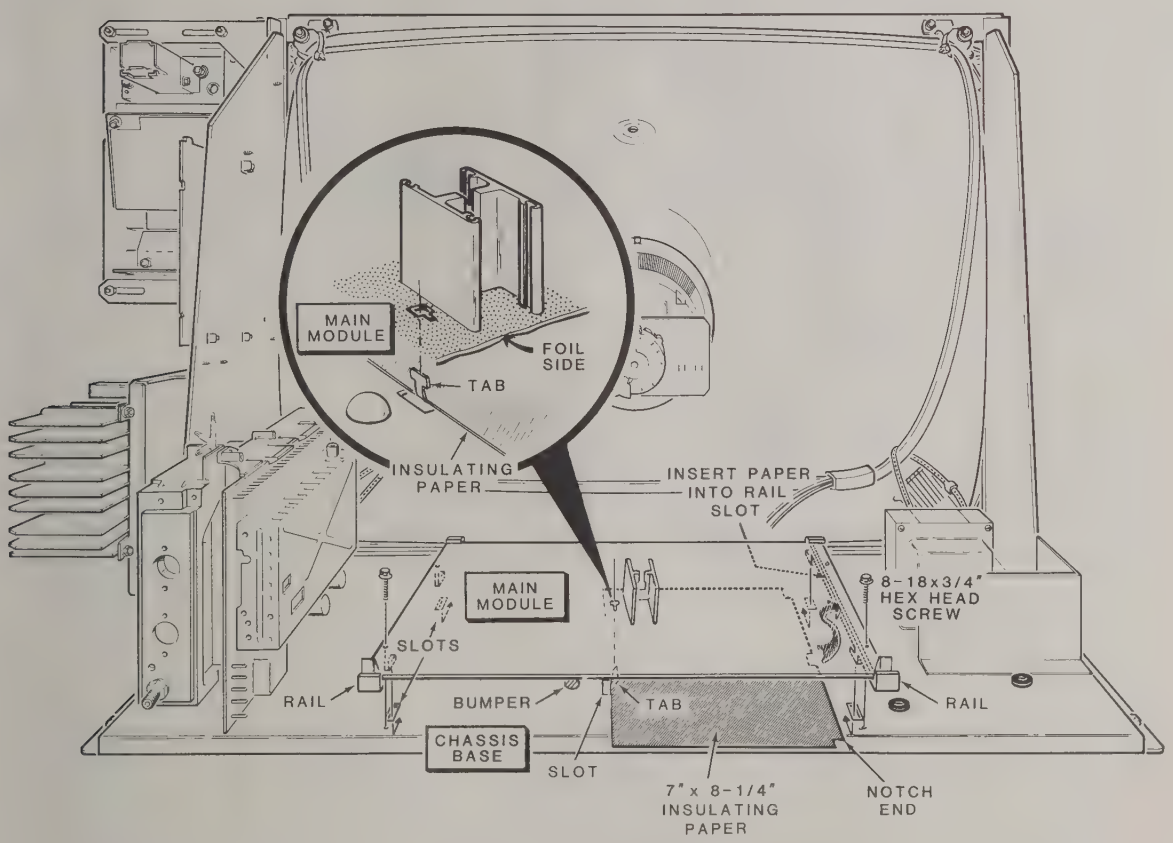
Refer to Detail 2-9A for the following two steps.

( ) Remove the backing from the rubber bumper and press the bumper onto the chassis next to the slot as shown.

( ) Position the insulating paper with the notches as shown. Then insert the right side of the insulating paper into the rail slot and press the tab into the main module cutout.

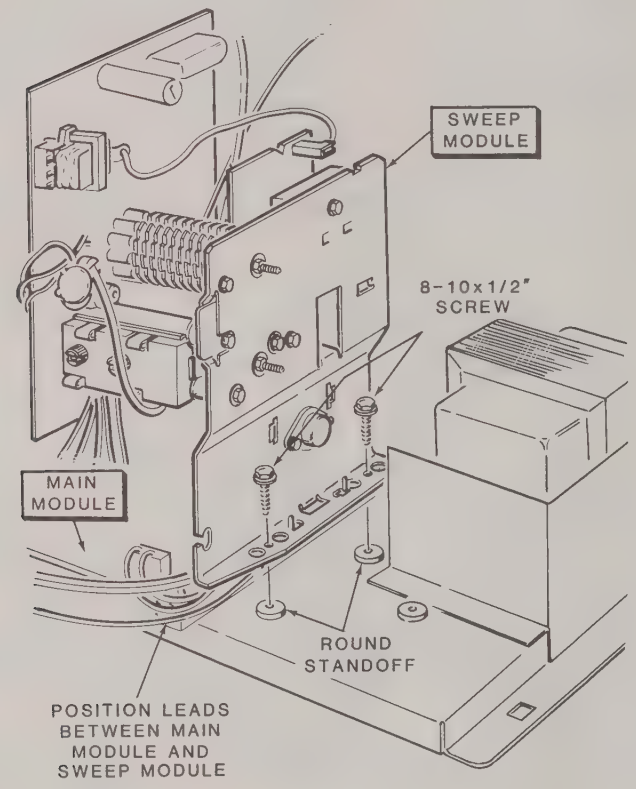
( ) Position all of the cable wires close to the bottom row of connectors on the tuner control module. Then insert the four tabs on the main module rails into the four chassis bottom slots. Push forward on the back of the rails to align the mounting holes. Then secure the circuit board to the chassis with two 8-18 × 3/4" hex head screws w/washers.

( ) Install one connector on cable 2C5/5A2 to main module plug 2C5 and the other connector to CRT socket assembly plug 5A2. NOTE: The board may be marked 25A instead of 5A2.



Detail 2-9A

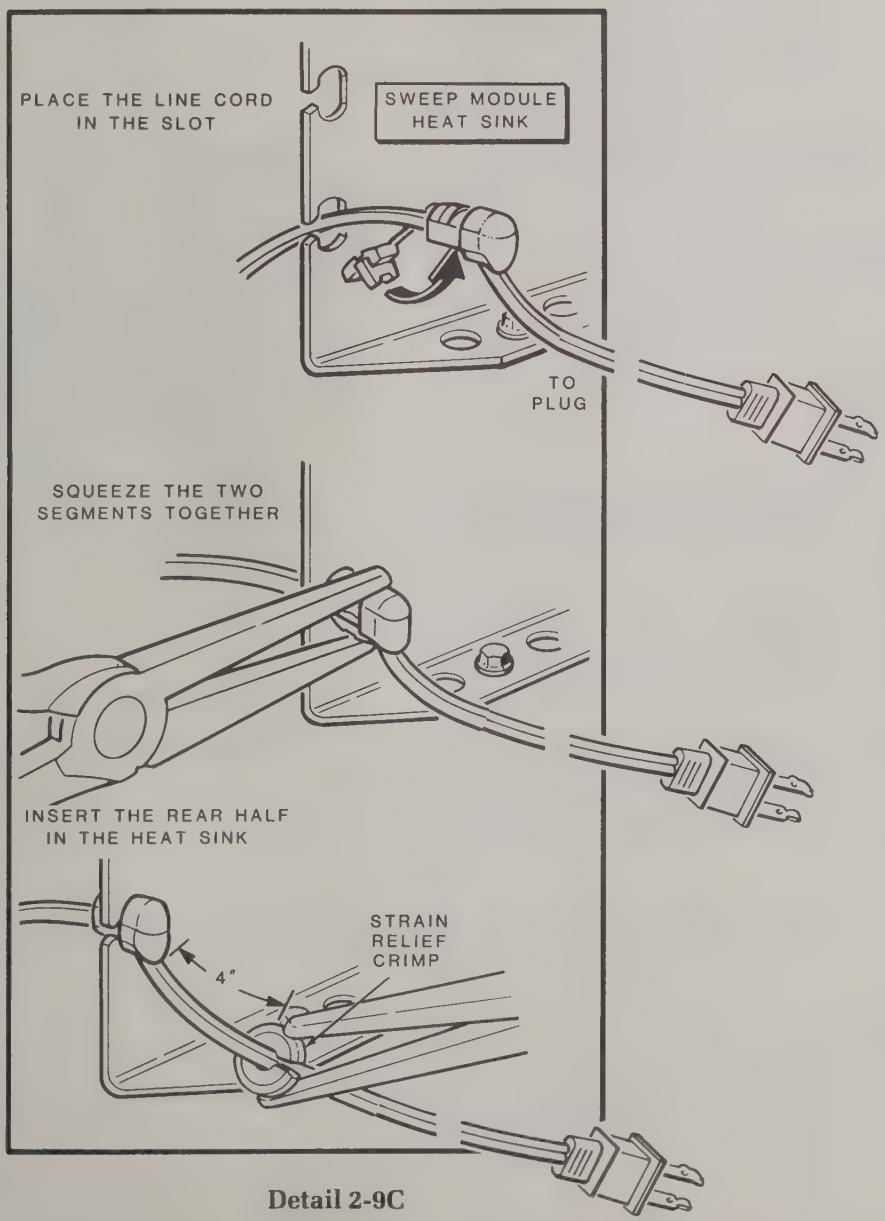
( ) Refer to Detail 2-9B and mount the sweep module to the chassis round standoffs with 8-10 × 1/2″ hex head screws. Route the cables coming from the power supply between the sweep module and the main module as shown.



Detail 2-9B

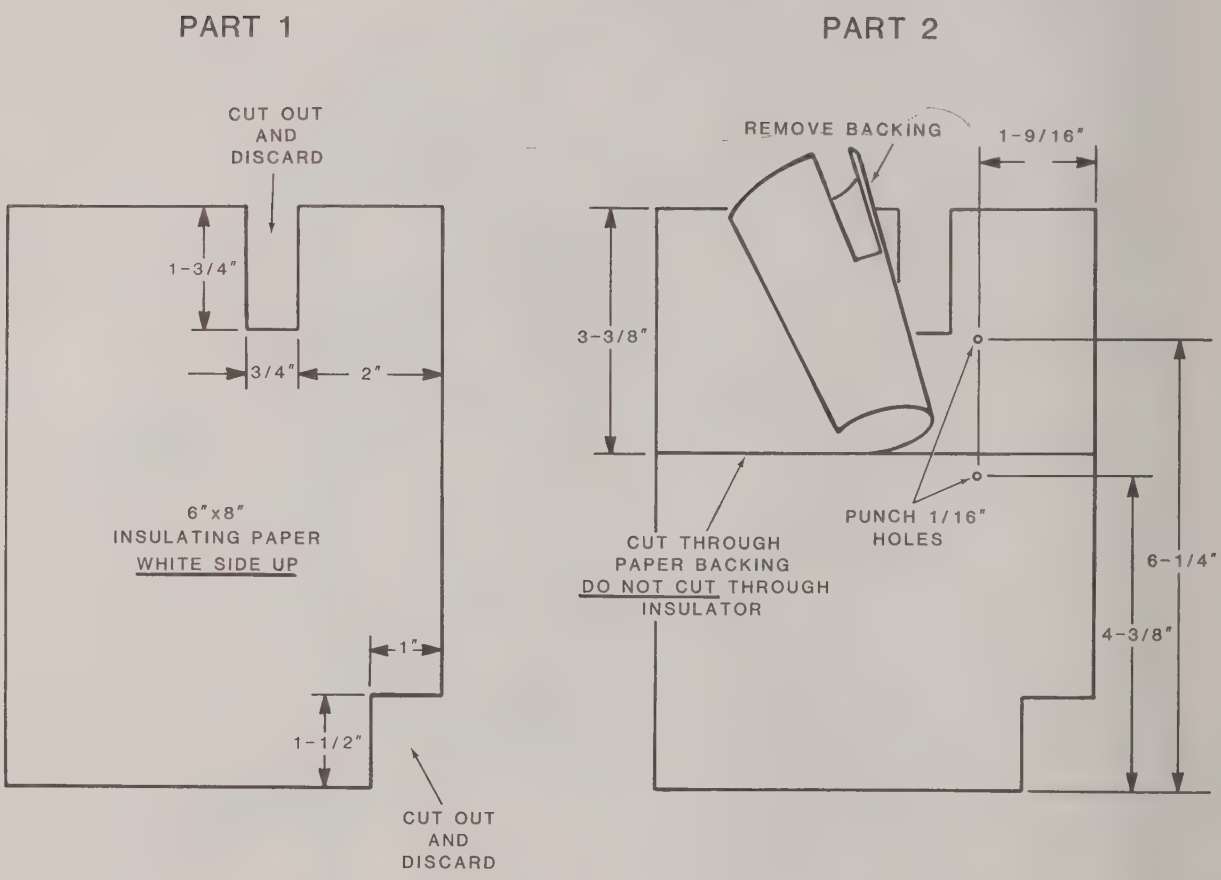
( ) Refer to Detail 2-9C and install the strain relief on the line cord. Route the line cord through the bottom slot in the sweep module heat sink so there is sufficient slack between the terminal strip and the slot. Then insert the strain relief into the sweep module heat sink cutout as shown. Make sure you install the strain relief so the line cord plug exits away from the main module.

( ) Refer to Detail 2-9C and slide the strain relief crimp over the line cord approximately 4" from the strain relief and crimp it in place with a pair of pliers.

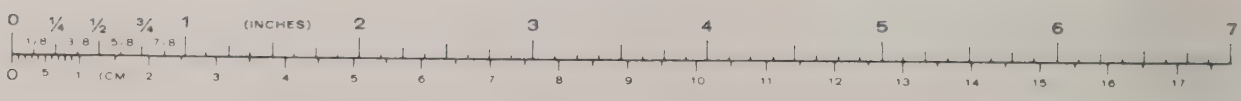

PLACE THE LINE CORD IN THE SLOT
SWEEP MODULE HEAT SINK
TO PLUG
SQUEEZE THE TWO SEGMENTS TOGETHER
INSERT THE REAR HALF IN THE HEAT SINK
STRAIN RELIEF CRIMP
4"

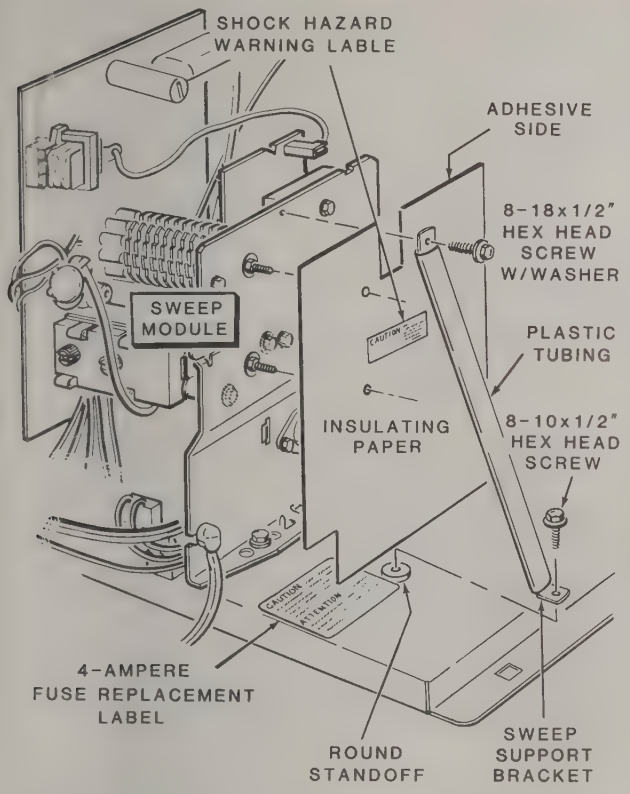
Detail 2-9C

( ) Refer to Detail 2-9D and prepare the 6″ × 8″ insulating paper as shown.



Detail 2-9D





Detail 2-9E

Refer to Detail 2-9E for the following steps.

( ) Slide the holes in the prepared insulating paper over the screws on the sweep module and press the adhesive section of the paper against the heat sink.

( ) Slide the piece of plastic tubing over the sweep support bracket.

( ) Connect the indicated end of the sweep support bracket to the round standoff with an 8-10 × 1/2" hex head screw and the other end to the sweep module heat sink with an 8-18 × 1/2" hex head screw w/washer.

( ) Press the shock hazzard warning label onto the insulating paper of the sweep module.

( ) Press the 4.00-ampere fuse replacement label on the chassis near the sweep module.

Refer to Pictorial 2-9 and install the connectors coming from the sweep module as follows. Keep the cables as neat as possible.

( ) Connector 3V3 to main module plug 3V3.

( ) Connector 3G3 to main module plug 3G3.

( ) Connector 3D3 to main module plug 3D3.

( ) Connector 3F3 to main module plug 3F3.

( ) Connector 5X3 to CRT socket module plug 5X3.

( ) Connector 5H3 to CRT socket module plug 5H3.

( ) If the gray wire is installed on your sweep module, install the connector on the end of it to the indicated tab of the CRT contact spring as shown in inset drawing #1.

( ) Install the 3S3 connector coming from the yoke assembly to the sweep module. Route the cable as shown.

( ) Install the 2A3 connector coming from the yoke assembly to sweep module plug 2A3. Route the cable as shown.

( ) Connect the 2-hole connector with the black and white wires coming from the CRT socket module to the 2-hole connector with the two large wires coming from the sweep module.

WARNING: In the next step, do not touch the CRT high voltage anode connection. Touch only the rubber insulated portion of the lead. When you install the anode lead, be sure it goes all the way into the anode socket.

( ) Connect the anode wire connector coming from the sweep module as shown in inset drawing #2.

( ) Install an 11-1/2" cable tie around the degaussing coil and the anode lead. Do not pull the cable tie tight but make it small enough to take up most of the anode lead slack. Cut off the excess cable tie.

( ) Prepare the following black stranded wires. To prepare a stranded wire, cut the wire to the indicated length and remove 1/4" of insulation from both ends. Then twist the fine wire strands tightly together and melt a small amount of solder on them to hold them in place.

11-1/2"
15-1/4"
15-1/4"

Refer to Detail 2-9F for the following steps.

( ) Crimp and solder a push-on connector on one end of the 11-1/2" black stranded wire as shown in inset #3 of Pictorial 2-9.

( ) Crimp and solder the free end of the 11-1/2" black stranded wire to #10 solder lug N. Leave room to connect the other two wire ends in the following steps.

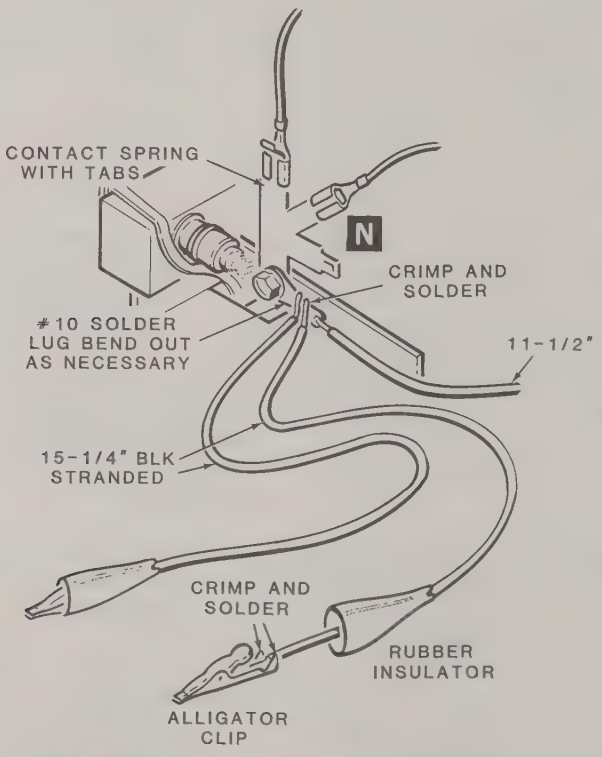
( ) Slide the push-on connector on the end of the 11-1/2" black stranded wire over the #6 solder lug at the left support bracket.

( ) Slide a rubber insulator over one end of each 15-1/4" black stranded wire 2" from the ends. Then crimp and solder an alligator clip on the insulator end of each 15-1/4" black stranded wire. When the connections cool, slide the rubber insulators over the alligator clips.

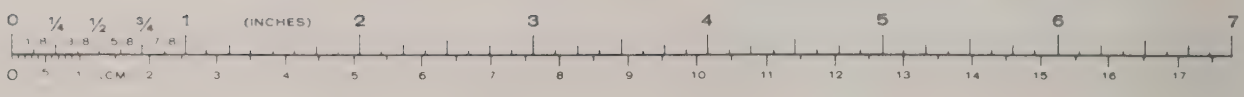
( ) Remove an additional 1/4" of insulation (1/2" total) from the other end of the 15-1/4" black stranded wires.

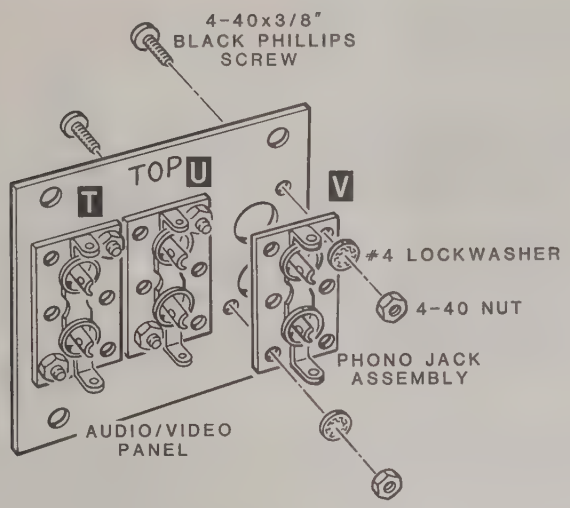
( ) Crimp and solder the 1/2" prepared ends of the 15-1/4" black stranded wires around the end of #10 solder lug N at the contact spring w/tabs. Bend the lug out as necessary.

( ) Connect either shorting clip to pin 6U9 on the tuner control module.



Detail 2-9F





Detail 2-11A

( ) Refer to Pictorial 2-10 (Illustration Booklet, Page 15) and install large, medium, and small wire twists around the wires at locations 1, 2, and 3 on the Pictorial.

AUDIO/VIDEO PANEL ASSEMBLY AND WIRING

Refer to Pictorial 2-11 (Illustration Booklet, Page 16) for the following steps.

( ) Position the audio/video panel with the printing right side up and turn the panel over. Write "TOP" at the top of the panel with a pencil or a pen.

( ) Refer to Detail 2-11A and mount a phono jack assembly to the inside of the audio/video panel at V with 4-40 × 3/8" black phillips hardware. Center the jacks in the panel holes before you tighten the screws.

( ) Similarly mount phono jack assemblies to the inside of the audio/video panel at U and T with 4-40 × 3/8" black phillips hardware.

( ) Cut six 1/4" pieces of fiber sleeving.

( ) Position the audio/video panel with the TOP facing up.

Connect the leads coming from cable 2B to the Video/Audio Output jacks as follows:

( ) Connect the inner lead of the white unmarked cable to the center pin of the Video Output jack (S-1). Slide a 1/4" piece of fiber sleeving over the shield lead and connect it to the ground lug (S-1).

( ) Connect the inner lead of the blue marked cable to the center pin of the Audio Output jack (S-1). Slide a 1/4" piece of fiber sleeving over the shield lead and connect it to the ground lug (S-1).

Connect the leads coming from cable 2A to the Video/Audio Input jacks as follows:

( ) Connect the inner lead of the white unmarked cable to the center pin of the Video Input jack (S-1). Slide a 1/4" piece of fiber sleeving over the shield lead and connect it to the ground lug (S-1).

( ) Connect the inner lead of the blue marked cable to the center pin of the Audio Input jack (S-1). Slide a 1/4" piece of fiber sleeving over the shield lead and connect it to the ground lug (S-1).

Connect the leads coming from cable 8F4 to the Stereo Input jacks as follows:

( ) Connect the cable with the unmarked inner lead to the center pin of Stereo Input jack L (S-1). Slide a 1/4″ piece of fiber sleeving over the shield lead and connect it to the ground lug at L (S-1).

( ) Connect the cable with the marked inner lead to the center pin of Stereo Input jack R (S-1). Slide a 1/4″ piece of fiber sleeving over the shield lead and connect it to the ground lug at R (S-1).

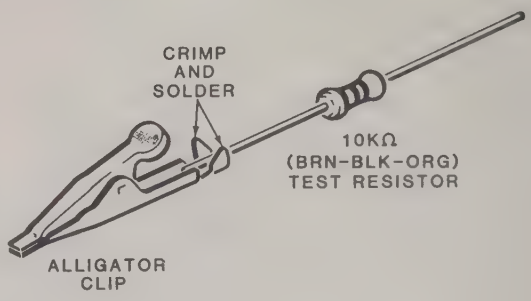
( ) Install a small wire twist around the cables coming from the audio/video panel 6″ from the panel.

( ) Connect cable connector 8F4 to amplifier module plug 8F4.

( ) Connect cable connector 2A to audio/video input/output module plug 2A.

( ) Connect cable connector 2B to audio/video input/output module plug 2B.

( ) Lay the audio/video panel loose inside the chassis. You will mount it later.



PICTORIAL 2-12

( ) Refer to Pictorial 2-12, and crimp and solder an alligator clip to one end of the 10 kΩ (brn-blk-org) test resistor as shown. Set the test resistor assembly aside. You will use it during the alignment of your TV.

Refer to Pictorial 2-13 (Illustration Booklet, Page 16) for the following steps.

NOTE: Before you install the TV at its final location, you will install the speakers and audio transformer on your work surface, or some other suitable location, to make the adjustments and convergence easier. When you handle the speakers in the following steps, be careful not to damage the delicate paper cones. may not be same as PTC.

( ) Position 2″ and 5″ × 7″ speakers on the left and right sides of the TV assembly with the speaker cones facing the front.

( ) Position the transformer w/connectors 8A8-8T8 near the audio amplifier.

( ) Connect power transformer connectors 8A8 and 8T8 to audio amplifier module plugs 8A8 and 8T8.

( ) Connect left speaker connector 8B4 to audio amplifier plug 8B4.

( ) Connect right speaker connector 8J4 to audio amplifier plug 8J4.

Connect the terminals with one wire on the end of cable 8B4 to the left 2″ speaker as follows:

( ) Violet wire to the lug with the identification mark and the capacitor lead; and the white wire to the lug with no capacitor connected to it.

Connect the terminals with two wires on the end of cable 8B4 to the left 5″ × 7″ speaker as follows:

( ) Violet and white wires to the lug with the identification mark, and the two white wires to the other lug.

Connect the terminals with one wire on the end of cable 8J4 to the right 2″ speaker as follows:

( ) Violet wire to the lug with the identification mark and the capacitor lead; and the white wire to the lug with no capacitor connected to it.

Connect the terminals with two wires on the end of cable 8J4 to the right 5″ × 7″ speaker as follows:

( ) Violet and white wires to the lug with the identification mark; and the two white wires to the other lug.

Proceed to "Initial Tests, Adjustments, And Installation" on Page 59.

INITIAL TESTS, ADJUSTMENTS, AND INSTALLATION

NORMAL OPERATING CHARACTERISTICS

When you first turn the TV Set on, and for several days later, you may hear occasional snapping (arcing). This arcing is normal, and may sometimes be quite loud. The arcing occurs between the elements of the picture tube during its initial aging process. This arcing may occasionally be strong enough to turn the Set off. If this happens, simply push the POWER button to turn the TV Set back on.

The TV Set may make a sizzling sound when you turn it on or off. This is normal and is caused by the picture tube charging and discharging.

INITIAL TESTS

PRIMARY WIRING TESTS

NOTE: You will need a VTVM or VOM (digital or analog type) to perform the following tests. If one is not available, proceed to "Adjustments."

A wiring error in the primary wiring circuit (line cord, power supply assembly, etc.) of your kit could cause you to receive a severe electrical shock. These "Primary Wiring Tests" will help you eliminate any such errors that may exist. If you do not obtain the indicated results during these tests, proceed to "In Case Of Difficulty" on Page ☛. Do not proceed with any further tests until you have located and corrected the problem. 101

( ) Set the ohmmeter to read 2 MΩ or greater.

( ) Connect the black (negative) ohmmeter lead to the chassis base. Leave this lead connected to the chassis until you are instructed to disconnect it.

( ) Touch the red (positive) ohmmeter lead to first one line cord plug prong and then to the other plug prong. The ohmmeter should indicate greater than 2 MΩ at each prong.

( ) Set the ohmmeter to read at least 150 Ω.

( ) Touch the red ohmmeter lead to one line cord plug prong and the common ohmmeter lead to the other prong. It should indicate approximately 85 Ω.

( ) Disconnect the ohmmeter leads and set the meter aside.

This completes the "Primary Wiring Tests." Proceed to "Adjustments."

ADJUSTMENTS

PREPARATION

Refer to Pictorial 3-1 (Illustration Booklet, Page 17) and Pictorial 3-5 (Page 67) for the following steps.

( ) Refer to Detail 3-1A and cut off the indicated end of the alignment tool. Then push the other end of the alignment tool into the small end of the nut starter and tape the two together.

( ) Rotate the tabs of the purity, 4-pole, and 6-pole, magnets so they are positioned at the top of the yoke as shown in inset drawing #1 on Pictorial 3-1.

( ) Set the G2 control on the sweep module to its center of rotation.

( ) On the crosshatch circuit board, set the NORMAL/CROSSHATCH switch to the NORMAL position.

( ) On the control escutcheon, open the door and turn the PICTURE, BLACK LEVEL, and COLOR LEVEL controls fully counterclockwise.

( ) Set the TINT and SHARPNESS controls to the center of their rotation. (The SHARPNESS control has a detent at its center position.)

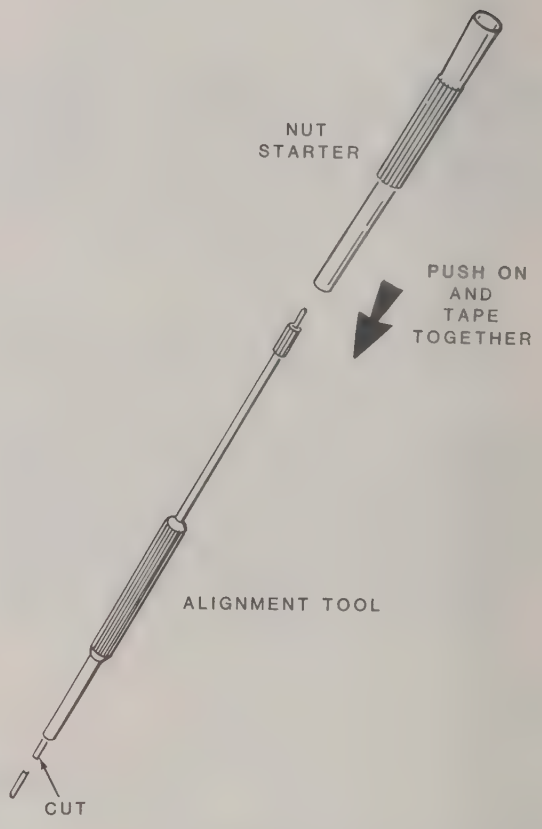
( ) Set the COLOR SENTRY switch to its OFF position.

( ) Set the BASS, TREBLE, and BALANCE controls to their center of rotation positions.

( ) Set the AUDIO SOURCE and VIDEO SOURCE switches to "TV".

( ) Set the slide switches on the front panel as follows:

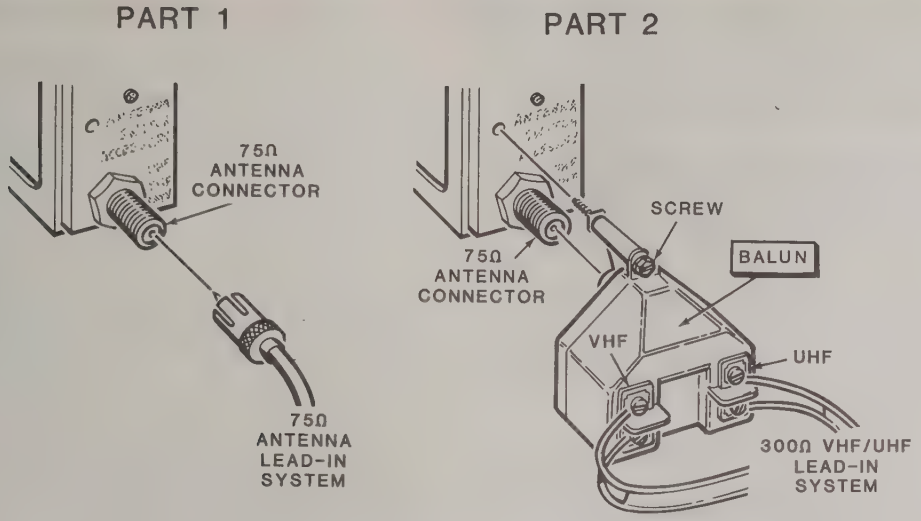
REMOTE/MANUAL	to	MANUAL
AFC	to	NORM
BAND	to	VHF/UHF
RING	to	OFF



Detail 3-1A

( ) If you have a 75 Ω antenna lead-in system, connect the antenna lead-in directly to the 75 Ω antenna connector on the adapter mounting bracket as shown in Part 1 of Detail 3-1B. If you have a 300 Ω VHF/UHF lead-in system, connect the antenna balun to the 75 Ω antenna connector as shown in Part 2 of Detail 3-1B. Use the screw that is attached to the balun to mount it to the Set. Then connect the lead-in wire(s) to the proper indicated VHF and UHF terminals. (Refer to "Antennas" on Page 81 if necessary.)

( ) Use a grease pencil or a similar marker to place a small dot (1/8" diameter maximum) in the center of the screen.



Detail 3-1B

WARNING: Extremely high voltage (26,000 volts) is present on the sweep module and the 2nd anode of the picture tube. Be very careful that you do not touch any of these parts while the TV Set is in operation. A safe rule to remember when you work around high voltage is to use only one hand to work on the circuit and keep the other hand behind you. This helps prevent your body from becoming part of an electrical circuit from high voltage to ground.

If any sign of malfunctioning appears in the following step, turn the Set off and disconnect the line cord from the wall outlet. Then refer to the "In Case Of Difficulty" on Page [illegible]. Do not operate the Set until you have located and corrected the problem since prolonged operation of a malfunctioning TV Set could result in damaged integrated circuits, transistors, or other components.

( ) Plug the line cord into a 120 VAC wall outlet and press the front panel POWER keypad. The screen may or may not light up and there may or may not be sound. Do not attempt to tune in a station at this time. Due to the warm-up time for the picture tube, you may or may not see the channel number and time display in the lower right-hand corner of the screen. This display will be on for only a few moments and then turn off. If it is visible, the time display will be all zeros.

( ) Use the keyboard and select a station with a strong signal in your area. For example, push 2, 8, and ENTER, and channel 28 will be selected.

( ) Turn the PICTURE control clockwise to be sure you have a moderately bright picture. The picture may or may not fill the screen at this time. Leave the control at this setting.

NOTE: You may find it helpful to use a mirror to view the screen while you perform the following steps.

( ) Press the POWER keypad to turn the Set off.

( ) Refer to inset drawing #2 and unplug the "Normal/Set-Up" shorting plug at 4L on the main module, turn it 90° counterclockwise, and reinstall it.

( ) Press the POWER keypad to turn the Set on.

CAUTION: The horizontal output transistor heat sink has voltage on it. Do not touch it when you make the adjustment in the next step.

( ) Adjust the G2 control on the sweep module until the entire screen is just lit. NOTE: Disregard any white diagonal lines on the screen. Also disregard the bright white line at the bottom of the screen.

( ) Press the POWER keypad to turn the Set off.

( ) Unplug the "Normal/Set-Up" shorting plug at 4L, turn it 90° clockwise, and reinstall it.

( ) Press the POWER keypad to turn the Set on.

( ) Adjust the FOCUS control on the sweep module to make the picture as sharp as possible at the center of the screen.

( ) Push and hold the VOLUME UP (↑) keypad for a few seconds. If your TV Set does not seem to have enough volume, turn the VOLUME PRESET control on the main module clockwise for the desired maximum level.

( ) Push and hold the VOLUME DOWN (↓) keypad for a few seconds. If your TV Set does not reach minimum volume (no sound), adjust the VOLUME PRESET control R1479 counterclockwise until it does.

( ) Press the POWER keypad to turn the Set off.

NOTE: Disregard any of the main module resistor numbers in the following step. Use the numbers shown on the illustration.

( ) Refer to inset drawing #3 and use a pair of long nosed pliers to raise the indicated leads of resistors R2506, R2507, and R2508 off the main module. This will make connections to these leads easier during the alignment. NOTE: Resistor R2508 may be screened R2506 on the board.

CONVERGENCE AND PURITY ADJUSTMENTS

When you complete the "Convergence and Purity Adjustments," you should have:

1. A screen that is all one color with no discolorations.

2. The picture centered on the screen.

3. Straight crosshatch lines on the screen.

( ) Press the POWER keypad to turn the Set on.

( ) Set the NORMAL-CROSSHATCH switch on the crosshatch circuit board to the CROSSHATCH position. NOTE: you must be receiving a strong signal from the antenna for a stable crosshatch pattern.

( ) Adjust the crosshatch control for a visible pattern on the screen, but not too bright. If the display is not bright enough, advance the BLACK LEVEL control clockwise until it is.

( ) Clip the unused shorting clip (you should have the other connected to pin 6U9) to the indicated lead of resistor R2507 on the main module. Route the clip lead through the adapter mounting bracket.

( ) Carefully loosen the clamp screw on the yoke and slide the yoke back as far as possible on the picture tube neck.

( ) If the lines on the screen are not horizontal and vertical, rotate the yoke on the neck of the picture tube as necessary until they are. Then retighten the yoke screw just enough to firmly hold it in place.

( ) Adjust the VERT HEIGHT control on the main module until you can see both ends of the vertical lines.

NOTE: Refer to inset drawing #4 for the location of the purity, 4-pole, and 6-pole magnets.

( ) Spread and then rotate the purity magnets simultaneously, as necessary, so you have the crosshatch pattern **centered** on the screen **horizontally** with the lines **straight**. NOTE: Adjust the tabs as best you can so each end of the lines are off the screen by the same amount and so the lines are straight. The purity ring tabs may end up in **any** final position around the neck of the picture tube.

4-POLE MAGNET ADJUSTMENT

( ) Spread the tabs of the 4-pole magnet to converge the red and blue **vertical** lines at the center of the screen to obtain magenta (purple) lines. NOTE: When you have these tabs correctly adjusted, they should be within the 45° arc shown in inset drawing #5 on Pictorial 3-1.

( ) **Rotate the 4-pole magnet tabs simultaneously** around the neck of the picture tube to converge the **horizontal** lines at the **center** of the screen.

( ) Remove the shorting clip from resistor R2507 and green lines may appear. NOTE: If these lines are converged already on top of the red and blue lines, the lines will appear white. Clip the shorting lead to its wire back near the mounting screw out of the way. Keep the shorting clip(s) in this position whenever you are not using them.

NOTE: If you were able to converge the vertical and horizontal lines at the center of the screen to obtain white lines, skip the "6-Pole Magnet Adjustment" and proceed to "Purity Adjustments."

6-POLE MAGNET ADJUSTMENT

( ) Spread the tabs of the 6-pole magnet to move the converged red and blue vertical lines on top of the green vertical lines to obtain white lines. NOTE: When you have the tabs correctly adjusted, they should be within the 30° arc shown in inset drawing #5 on Pictorial 3-1.

( ) Rotate the 6-pole magnet tabs simultaneously around the tube neck to converge the horizontal lines at the center of the screen.

NOTE: Since there is some interaction between the 4- and 6-pole magnets, it will be necessary to make slight readjustments to the 4-pole magnets to obtain the proper convergence.

PURITY ADJUSTMENTS

( ) Clip a shorting clip to the indicated lead of resistor R2506 on the main module.

( ) Remove the other shorting clip from pin 6U9 and connect it to the indicated lead of resistor R2508 on the main module. With this clip removed from the pin, there will be no sound.

( ) Refer to Photo A (fold-in) and adjust the tabs of the purity magnet until the screen exhibits all of the following:

A. The raster (illuminated screen) is centered on the picture tube.

B. The ends of the vertical lines are equal distances from the top and bottom of the picture tube mask opening.

C. The ends of the horizontal lines are equal distances from the sides of the picture tube mask opening. NOTE: The ends of these lines may be outside the mask opening.

D. The vertical line **nearest** the dot you placed in the center of the picture tube is pure green (with no other color shading). Do not try to center the entire green area over the dot.

( ) Loosen the yoke collar screw and push the yoke all the way forward until it is against the picture tube bell.

( ) Remove the shorting clip from resistor R2508, if installed, and reconnect it to the indicated lead of resistor R2507.

( ) Slowly pull the yoke back until the screen has pure red lines as shown in Photo B of Pictorial 3-2.

( ) If the lines are not pure red, readjust the purity magnet tabs slightly until they are pure red.

( ) Set the NORMAL-CROSSHATCH switch on the crosshatch circuit board to NORMAL and check the picture to make sure it is pure red; then return the switch to CROSSHATCH.

If you still cannot obtain pure red lines:

1. Remove the shorting clip from resistor R2507 and connect it to resistor R2508 and pull the yoke all the way back on the picture tube neck.

2. Adjust the tabs of the purity magnet to obtain a picture that matches Photo A (fold-in).

3. Push the yoke forward against the picture tube bell.

4. Remove the shorting clip from resistor R2508 and reconnect it to resistor R2507.

5. Rotate the yoke to straighten the crosshatch pattern if necessary.

6. Slowly pull the yoke back until the screen has pure red lines.

( ) Rotate the yoke as necessary to straighten the crosshatch pattern. Then tighten the yoke clamp screw just enough to hold the yoke securely to the picture tube neck.

( ) Remove the shorting clip from resistor R2507 and reconnect it to resistor R2508. The screen should have all green lines. Remove the shorting clip from resistor R2506 and reconnect it to resistor R2507. The screen should have all blue lines. Readjust the purity magnet tabs very slightly if necessary to obtain pure color lines.

( ) Remove the shorting clip from resistor R2508 and red and blue lines should appear on the screen.

( ) Adjust the FOCUS control on the sweep module to make the lines as sharp as possible at the center of the screen.

( ) Readjust the 4-pole magnet tabs to converge the red and blue **vertical** lines at the **center** of the screen. NOTE: When you have these tabs correctly adjusted, they should be within the 45° arc shown in inset drawing #5 on Pictorial 3-1 (Illustration Booklet, Page 17).

( ) Rotate the 4-pole magnet tabs **simultaneously** around the picture tube neck to converge the horizontal lines at the center of the screen.

( ) Remove the shorting clip from resistor R2507.

( ) Readjust the tabs of the 6-pole magnet to move the converged red and blue vertical lines over the green vertical lines to obtain white vertical lines. NOTE: When these tabs are correctly adjusted, they should be within the 30° arc shown in inset drawing #5 on Pictorial 3-1.

( ) Rotate the tabs **simultaneously** around the picture tube neck to converge the horizontal lines at the center of the screen.

( ) Set the NORMAL/CROSSHATCH switch on the crosshatch circuit board to the NORMAL position.

( ) Adjust the PICTURE and BLACK LEVEL front panel controls until you can see a picture on the screen.

( ) Adjust the VERT HEIGHT control on the main module until the picture fills the screen.

( ) Set the NORMAL/CROSSHATCH switch on the crosshatch circuit board to the CROSSHATCH position.

DYNAMIC CONVERGENCE

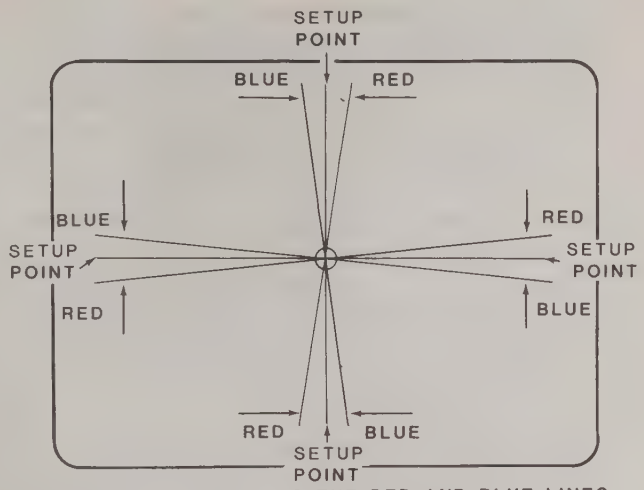
Refer to Pictorials 3-1 (Illustration Booklet, Page 17) and 3-3 for the following steps.

NOTE: Perfect convergence over the entire screen is not normally possible. Perform the adjustments in the following steps, for the best compromise in the top/bottom and left/right areas of the picture. It may be necessary to perform the convergence steps several times before you obtain the desired results.

( ) Connect a shorting clip to the indicated lead of resistor R2507.

NOTE: In the following steps, you will install rubber wedges. Note that the wedges have a section with adhesive backing. This adhesive will hold the wedges to the CRT once you position them at their proper locations. You will first install the wedges without removing the backing from the adhesive side to determine their correct location. Once you have the proper convergence, you will adhere the wedges to the CRT.

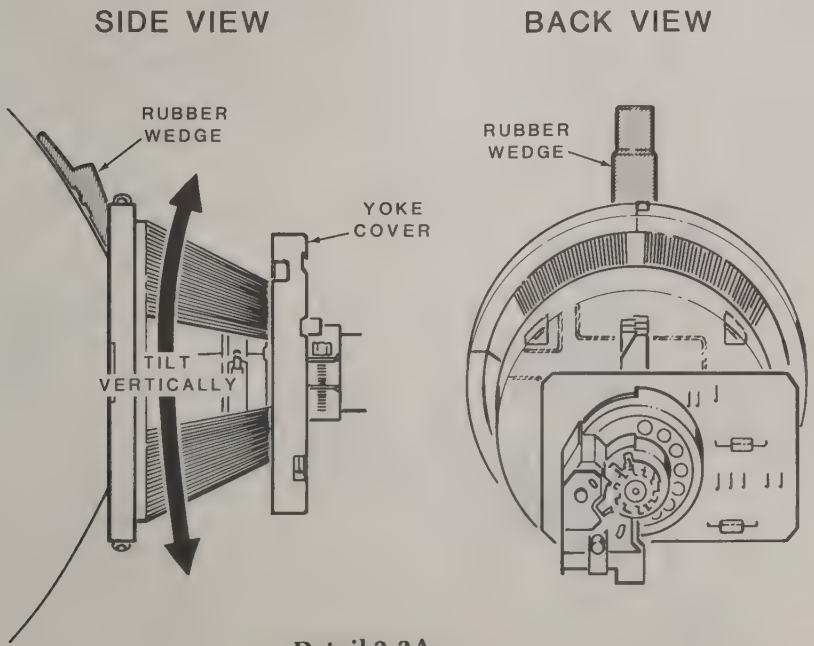
( ) While you hold the back cover of the yoke, tilt the yoke **vertically** and converge the ends of the center lines as shown in Pictorial 3-3.



VERTICAL TILT ROTATES THE RED AND BLUE LINES AROUND THE CENTER OF THE SCREEN.

PICTORIAL 3-3

Hold the yoke in this position and carefully insert a rubber wedge between the yoke and the picture tube until it is firmly in place as shown in Detail 3-3A. Once the wedge is in place, check to make sure the lines are still converged at the ends.



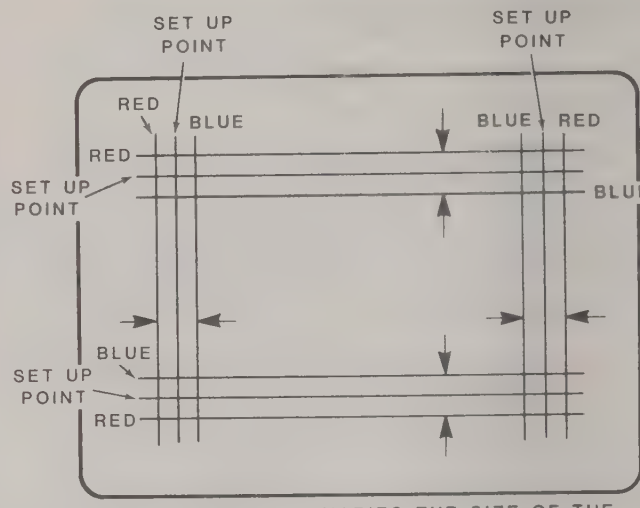
Detail 3-3A

( ) While you hold the back cover of the yoke, tilt the yoke **horizontally** and converge the red and blue lines of both sides as shown in Pictorial 3-4. Hold the yoke in this position and carefully insert a rubber wedge between the yoke and the picture tube approximately 90° from the top wedge until it is firmly in place as shown in Detail 3-4A. Do not disturb the yoke position.

( ) Carefully insert the remaining rubber wedge between the yoke and the picture tube at approximately 180° from the previously installed wedge as shown in Detail 3-4A.

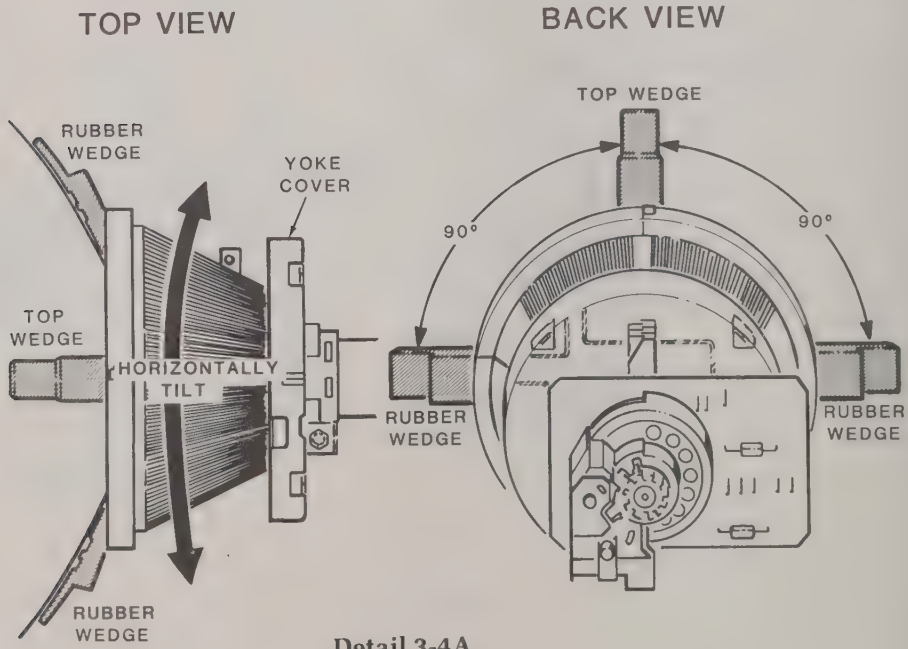
( ) Check the overall convergence at the four corner setup points of the picture tube as shown in Pictorial 3-4. If the picture is converged properly, carefully raise the end of each rubber wedge enough to remove the backing paper while you hold the wedge in place. Then press the adhesive side of the wedge to the picture tube so it adheres firmly.

( ) Set the NORMAL/CROSSHATCH switch on the crosshatch circuit board to the NORMAL position.



PICTORIAL 3-4

( ) Remove the shorting clip from resistor R2507 and reconnect it to pin 6U9 on the tuner control module. Make sure to route this lead through the adapter mounting bracket opening so it does not get pinched when you install the rear panel.



Detail 3-4A

BLACK LEVEL RANGE CONTROL

Refer to Pictorial 3-5 for the following steps.

( ) Turn the front panel PICTURE control fully counterclockwise and the front panel BLACK LEVEL control to the center (detent) of its rotation.

( ) Turn the front panel COLOR LEVEL control fully counterclockwise.

( ) Use the large end of the alignment tool and adjust the internal black level (BL) control through the small front panel hole. Adjust the control clockwise until you first have light on the screen.

AGC DELAY

Refer to Pictorial 3-1 (Illustration Booklet, Page 17) for the following steps.

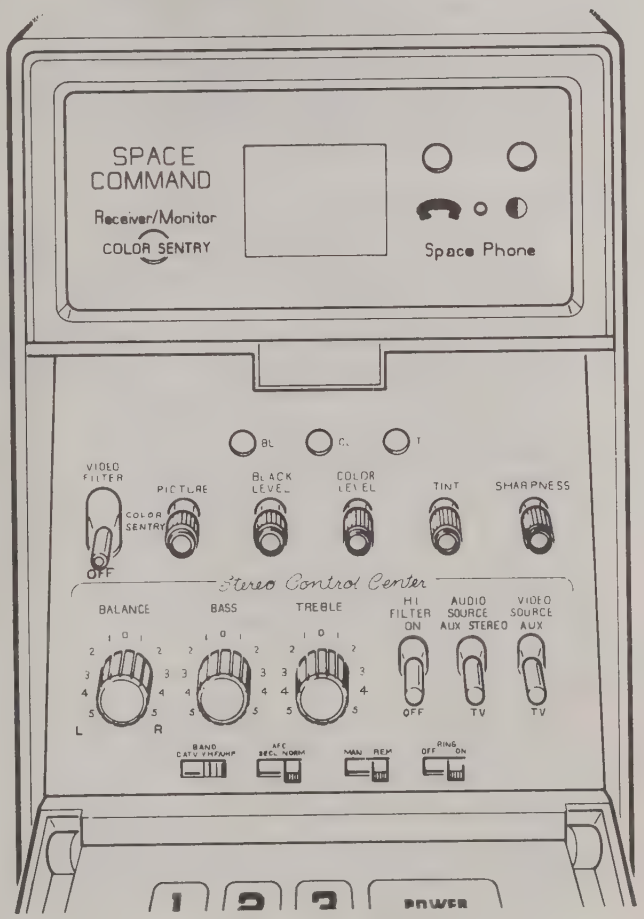
( ) Select the strongest channel in your area.

( ) Turn the front panel PICTURE control for a normal picture.

( ) Adjust the "AGC Delay" control (RR31)on the main module counterclockwise until the picture is snowy. Then adjust the control back until the snow is gone. If there is a channel 6 operating in your area, tune to this channel and adjust the AGC Delay control for minimum "beat" in the picture.

NOTE: If you are using a signal source other than a TV station (video game, video cassette recorder, etc.) with this TV Set, you may have to readjust the AGC Delay control.

( ) Press the POWER keypad to turn the Set off.



PICTORIAL 3-5

95V ADJUSTMENT

Refer again to Pictorial 3-1 for the following steps.

NOTE: You will need a digital voltmeter or an accurate VTVM, or VOM to perform the following steps. If you do not have, or cannot obtain a voltmeter, skip this section and proceed to "Color Sentry."

( ) Connect the meter's negative (common) lead to the sweep module heat sink. There is voltage present on this heat sink when the Set is on so be careful when you work around it.

( ) Connect the positive (+) voltmeter lead to the "95 V pin on the sweep module. below353

( ) Set the voltmeter to read 100 VDC full scale.

( ) Press the POWER keypad to turn the Set on and select a strong station.

( ) Adjust the front panel PICTURE control for no brightness on the screen.

( ) Adjust the 95 V control (R2771) for a reading of 95 volts ±.5 volts on the meter.

( ) Press the POWER keypad to turn the Set off and disconnect the meter leads.

COLOR SENTRY

( ) Adjust the front panel BLACK LEVEL and SHARPNESS controls to their center positions.

( ) Press the POWER keypad to turn the Set on and turn up the front panel PICTURE control for a normal picture.

( ) Adjust front panel COLOR LEVEL and TINT for the desired picture.

( ) Switch the control panel COLOR SENTRY switch to the on position. Then use the alignment tool to adjust the internal COLOR and TINT controls through the small front panel holes for the desired color tones. Leave the controls at this position for the following section.

SAFETY TEST

NOTE: If the high voltage in your Set were to malfunction and increase sufficiently in voltage, harmful X-rays could be produced. This Set has an automatic shut-down circuit to prevent this from occuring. The following test will ensure that this shutdown circuit is operating properly.

( ) Press the POWER keypad to turn the Set off.

( ) Locate the 10 kΩ test resistor and alligator clip you assembled earlier. Then refer to Pictorial 3-1 and connect the test resistor alligator clip to pin TP33 on the main module. Connect a shorting clip to the other end of the test resistor. Make sure the clips and resistor leads do not touch against any adjacent components.

( ) Press the POWER keypad to turn the Set on. There should be a flash of light on the screen and then the screen should go dark. You may hear a sound from the speakers.

NOTE: Make sure you disconnect the line cord in the next step; otherwise, the Set will not turn on.

( ) Turn off the TV Set and disconnect the line cord from the wall outlet. This will reset the protection circuitry.

( ) Remove the test resistor and shorting clip. Set the test resistor aside in a safe place in case you should need it at some other time.

This completes the "Safety Test." If the test did not produce the proper results, you should have the main module repaired. Refer to the "Service Facilities" section on Page 119.

FINAL TESTS

Refer to Pictorial 3-6 for the following steps.

( ) Plug the line cord back into the AC wall outlet and press the POWER keypad to turn the Set on.

( ) Push the keyboard TIME RECALL (RCL) keypad. Then use the TIME SET (HR SET and MIN SET) keypads and set the clock. The clock will now start keeping time.

( ) Set the MANUAL/REMOTE switch to REMOTE.

( ) Use the remote control transmitter and change the channel by pressing the new channel number(s) and then the ENTER/RECALL keypad.

( ) Press the POWER keypad to turn the Set off.

AUDIO AMPLIFIER CHECK

Refer to Pictorial 3-6 for the following steps.

( ) Set the front escutcheon BALANCE, BASS, and TREBLE controls to their center positions.

( ) Set the AUDIO SOURCE switch to the AUX STEREO position.

( ) Set the VIDEO SOURCE switch to the AUX position.

( ) Press the POWER keypad to turn the Set on.

( ) On the audio/video panel, touch the center pin of the "L" STEREO INPUT jack. You should hear hum from the left speakers.

( ) Touch the center pin of the "R" STEREO INPUT jack. You should hear hum from the right speakers.

( ) Press the POWER keypad to turn the Set off and disconnect the line cord.

( ) If installed, remove the antenna balun from the rear of the TV and set it aside.

( ) Use a soft cloth and remove the dot from the center of the picture tube.

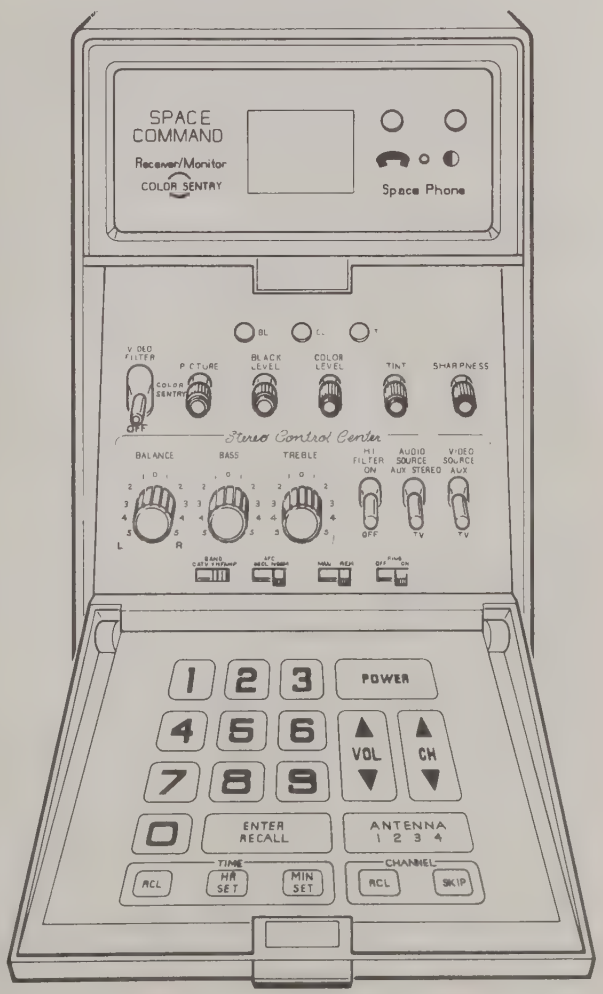
( ) Disconnect the speakers and power transformer from the audio amplifier.

( ) Disconnect the cable terminals from the left and right set of speakers. Set the speakers and transformer aside.

( ) Return the AUDIO and VIDEO SOURCE switches to the "TV" position (down).

This completes the "Initial Tests and Adjustments." If you have purchased the Space Phone Accessory, refer to that Manual at this time. If you have not purchased the accessory, you will now install your TV.

Your Television can be installed in one of two Heathkit cabinets or custom installed in a wall enclosure. If you intend to install your Television in one of the cabinets, proceed with "Cabinet Installation" on Page 71. If you plan to custom install your Television, skip this section and proceed to "Custom Installation" on Page 74.



PICTORIAL 3-6

CABINET INSTALLATION

NOTE: Two cabinet styles are available from the Heath Company for this Set: The GRA-706-25 Classic-style Cabinet and the GRA-716-25 Modern-style Cabinet.

Refer to Pictorial 3-7 (Illustration Booklet, Page 19) for the following steps.

( ) Unpack your cabinet and remove its back. Set the back and hardware aside.

( ) Mount a 2″ speaker to its mounting studs on the left-hand side of the cabinet with two #6 flat washers and 6-32 nuts. Position the speaker with the lugs as shown.

( ) Mount a 5″ × 7″ speaker to its mounting studs on the left-hand side of the cabinet with four #6 flat washers and 6-32 nuts. Position the speaker with the lugs as shown.

( ) Similarly mount a 2″ and a 5″ × 7″ speaker to the inside of the cabinet on the right-hand side with the lugs positioned as shown.

Connect the terminals with a single wire on the end of cable 8B4 to the 2″ speaker on the left-hand side of the cabinet as follows:

( ) Violet wire to the lug with the identification mark and the capacitor lead, and the white wire to the lug with no capacitor lead connected to it.

Connect the terminals with two wires on the end of cable 8B4 to the 5″ × 7″ speaker on the left-hand side of the cabinet as follows:

( ) Violet and white wires to the lug with the identification mark, and the two white wires to the other lug.

Position the cable to the far left side of the cabinet so it does not get in the way when you install the chassis. You will connect the connector end of this cable later.

Connect the terminals with a single wire on the end of cable 8J4 to the 2″ speaker on the right-hand side of the cabinet as follows:

( ) Violet wire to the lug with the identification mark and the capacitor lead, and the white wire to the lug with no capacitor connected to it.

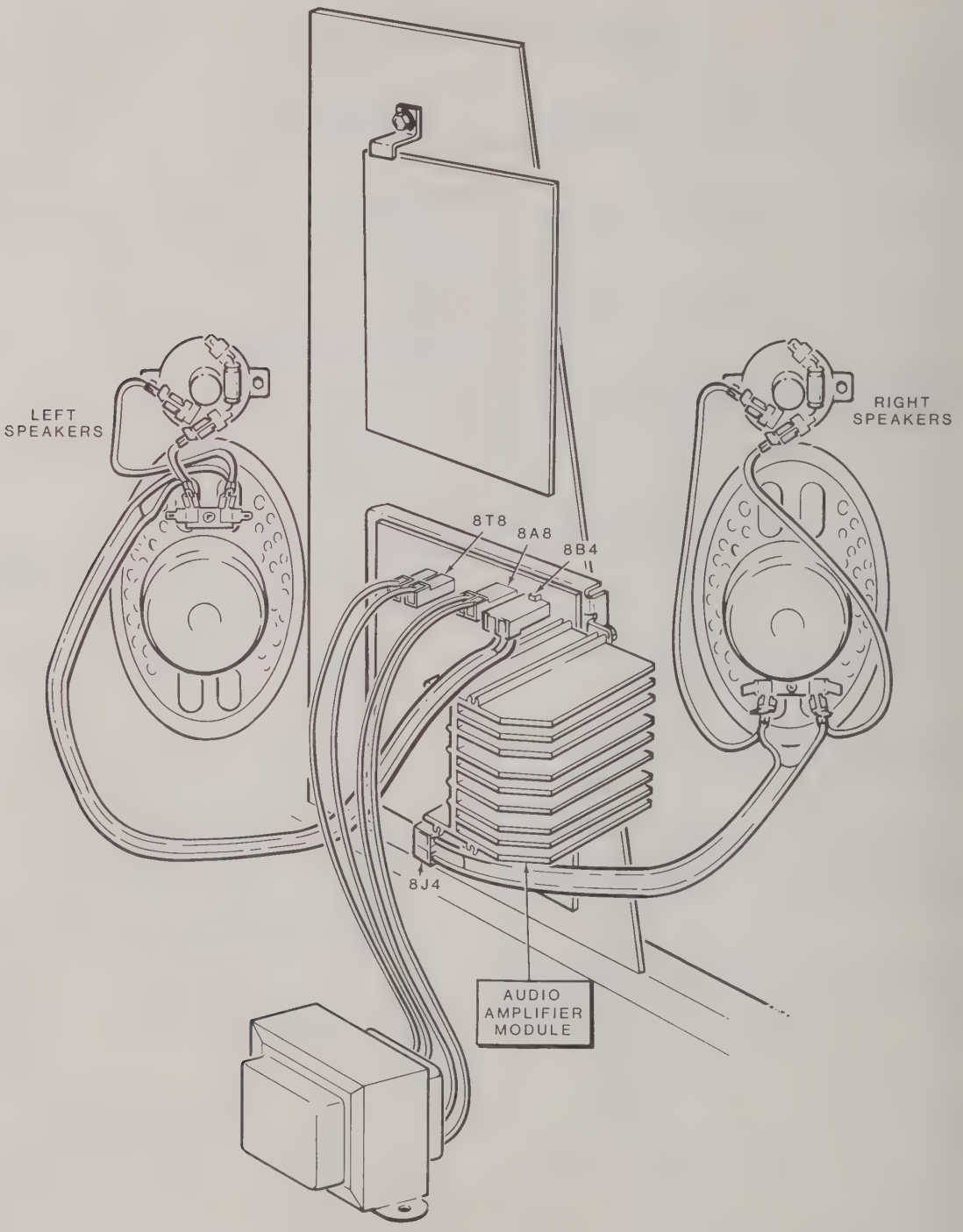
Connect the terminals with two wires on the end of cable 8J4 to the 5″ × 7″ speaker on the right-hand side of the cabinet as follows:

( ) Violet and white wires to the lug with the identification mark, and the two white wires to the other lug.

( ) Route cable 8J4 out the back of the cabinet. You will connect the end of the cable later.

( ) Mount the transformer w/connectors 8A8-8T8 to the inside of the cabinet at predrilled holes W and X with 8-15 × 3/4″ hex head screws. Position the transformer with the leads as shown and back out of the way so they do not get pinched when you install the chassis.

Proceed to "Chassis Installation."


LEFT
SPEAKERS
RIGHT
SPEAKERS
8T8
8A8
8B4
8J4
AUDIO
AMPLIFIER
MODULE

Detail 3-8A

CHASSIS INSTALLATION

Refer to Pictorial 3-8 (Illustration Booklet, Page 19) for the following steps.

NOTE: Use two people to install the chassis, since it is quite heavy.

( ) With the help of another person, tilt the Television as necessary so the top of the CRT mask clears the lip on the top of the cabinet. (See inset drawing #1.) Then lower the Set onto the cabinet shelf and slide it forward until the CRT mask is centered in the front opening. If the control escutcheon does not fit properly in its cutout, position it until it does. The support bracket hardware was left loose earlier so this could be done. You will tighten the hardware later. tighten hardware

( ) Once the CRT mask is properly centered in its cabinet opening, rotate the two mask mounting brackets up into the cabinet lip slot and tighten the mounting screws as shown in inset drawing #2.

( ) Secure the chassis to the cabinet shelf with four 1/4-20 bolts and 3/4" flat washers from the underside of the shelf.

( ) Center the control escutcheon in its cabinet cutout and secure the escutcheon to the cabinet with 8-15 × 3/4" hex head screws at the four predrilled holes.

( ) Mount the audio/video panel at the two predrilled hole locations on the cabinet lip with 8-15 × 3/4" hex head screws.

( ) Route the 8J4 cable over the chassis base between the CRT and the main module from right to left as shown.

Refer to Detail 3-8A for the following steps.

( ) Connect power transformer connectors 8A8 and 8T8 to audio amplifier module plugs 8A8 and 8T8.

( ) Connect left speaker connector 8B4 to audio amplifier plug 8B4.

( ) Connect right speaker connector 8J4 to audio amplifier plug 8J4.

This completes the installation of your Television. NOTE: If you do not intend to assemble the Space Phone Accessory, proceed to "Final Assembly" on Page 81. If you intend to assemble the Space Phone Accessory, refer to that Manual and assemble and install it at this time. Then return to "Final Assembly" in this Manual.

CUSTOM INSTALLATION

This part of the Manual describes only one of the many methods of custom mounting your Television Set. This method requires you to have sufficient space behind the shelf so you can mount the enclosure, the audio/video panel, and the rear panel after the TV has been securely mounted on the shelf. Also, there are several important things to consider when you plan a custom installation; these are briefly described in the following paragraphs.

Carefully consider the angle from which you will view the TV since, after it is mounted, its position cannot be easily changed.

Be sure to provide adequate ventilation. TV sets develop a considerable amount of heat during prolonged operation. This heat must be able to escape or the set may be severely damaged, and the life of the electronic components shortened.

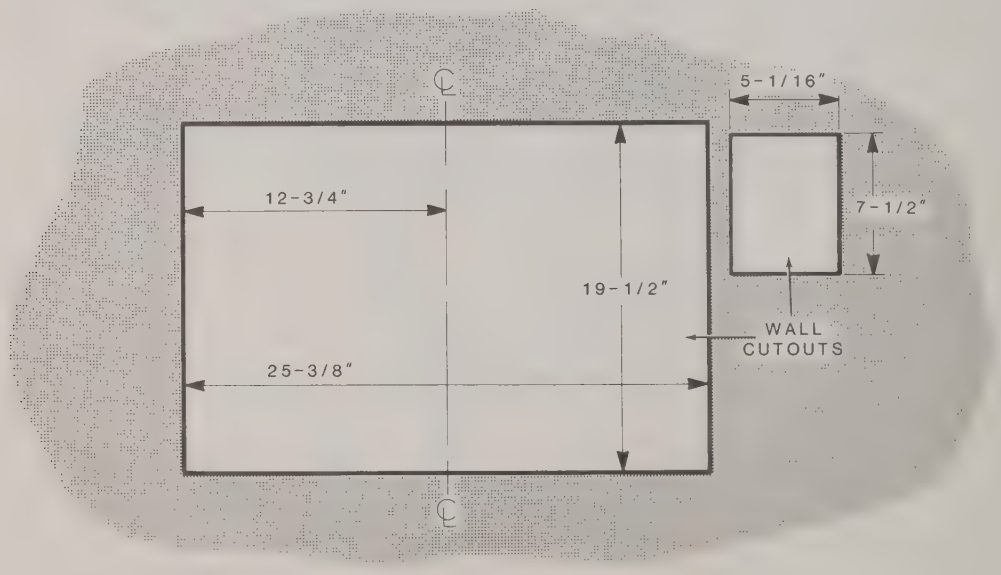
Be sure to provide easy access to the chassis and the jacks at the rear of the set, as you may have to converge the Set and make minor adjustments after the components age. Also, components should be accessible in case you should have to service the set at some future time.

CAUTION: YOU MUST OBSERVE THE FOLLOWING CONDITIONS WHEN YOU CUSTOM INSTALL YOUR TV SET.

After you make the wall opening and install the necessary header and/or wall studs, the exposed areas of the header and studs must be covered with 24-gauge (.024″ — .027″) sheet metal to conform to the National Electrical Code requirement for fire barrier use. The sheet metal should be coated (galvanized or painted) to resist rust and corrosion.

All of the TV Set that extends behind the wall opening must be covered with an enclosure made of 1/2″ plywood (or equivalent), and a rear panel must be mounted on the rear of the enclosure.

Pictorial 3-9 (Illustration Booklet, Page 21) shows a typical custom wall-mount installation. A decorative trim should be placed around the front of the TV Set and the speakers.



Detail 3-9A

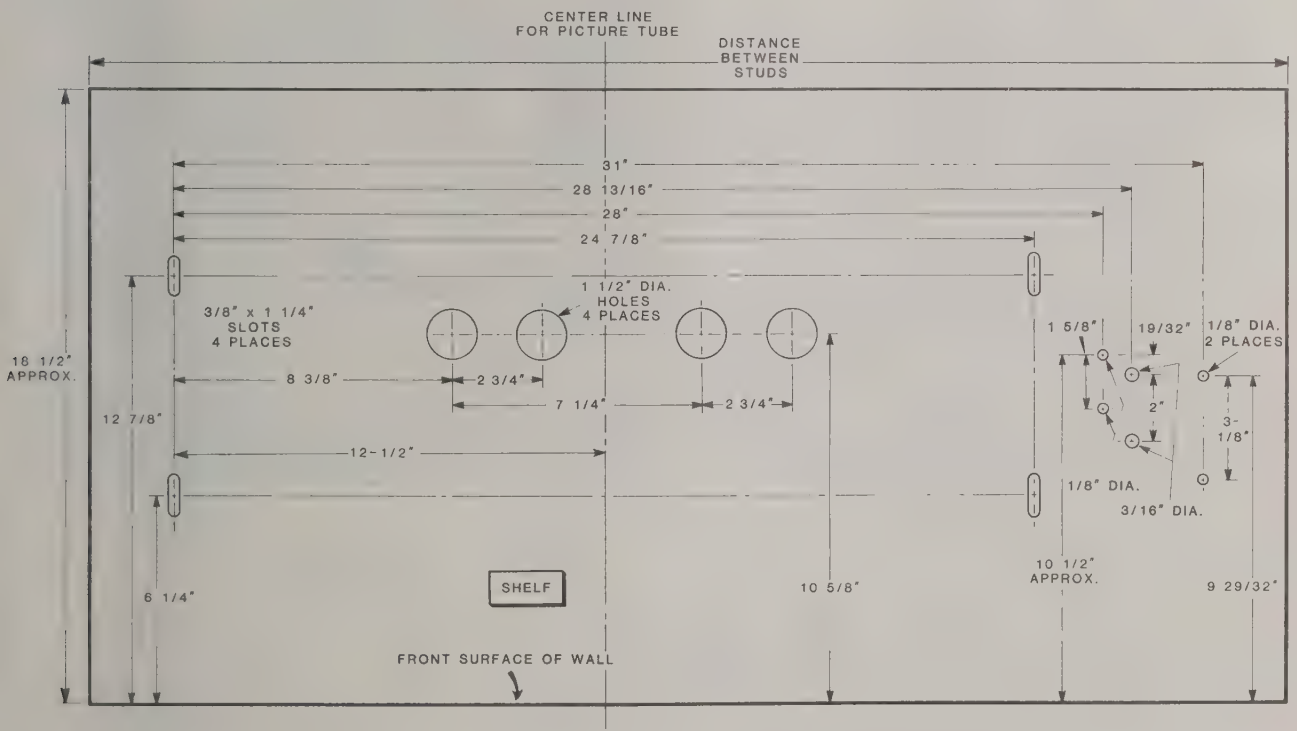
PREPARATION

WARNING: BEFORE YOU START TO CUT THE WALL, BE SURE THERE ARE NO HEATING DUCTS, ELECTRICAL WIRING, OR WATER PIPES CONCEALED IN THE WALL AREA WHERE YOU PLAN TO INSTALL THE TV SET.

1. Plan where you want to install your TV Set, control panel escutcheon, and speakers. Then refer to Detail 3-9A and carefully mark the wall where the Set will be installed. Be sure the corners are square and that all measurements are accurate. NOTE: The cutout dimensions are slightly larger than the actual dimensions (19-3/8″ × 25-1/4″) of your TV. This is to allow for the thickness of the fire barrier sheet metal and a slight margin for error.

2. Refer to Detail 3-9B and prepare the shelf using 3/4″ plywood. Make sure you cut the vents to the indicated sizes and position them as dimensioned. Cover all vents with #8 or #10 mesh wire screen.

3. Refer to Parts 1, 2, or 3 of Detail 3-9C (Illustration Booklet, Page 21) and mount the shelf on the wall studs and install the fire barrier.



Detail 3-9B

If speaker cutouts are required, prepare them now, using Detail 3-9D (Illustration Booklet, Page 55). This Pictorial is a full-size speaker template. Detail 3-9E shows the speakers installed one above the other.

MOUNTING THE SET

1. Refer to Pictorial 3-9 (Illustration Booklet, Page 21) and slide the TV Set onto the shelf. Position it so the holes nearest the rear end line up with the matching holes in the shelf.

2. Locate four of the 1/4-20 bolts and four 3/4" flat washers supplied with your TV Set.

3. From the bottom, insert these bolts with the washers through the holes in the shelf and start them into the self-retaining nuts in the chassis.

4. Move the TV Set until the CRT mask and control escutcheon is centered in the wall cutouts and so they protrude evenly from the front of the wall. Then securely tighten the screws against the shelf. Use four 8-15 × 3/4" screws to secure the control escutcheon to the front panel.

5. Refer to Detail 3-9F and connect cables 8B4 and 8J4 to the speaker lugs as shown. Be sure to observe the identification marks and wire colors when you connect the cable terminals to the speaker lugs. Insert the speaker cables up through the hole in the rear of the shelf. Then plug the cables into the audio/video input/output module plugs as follows:

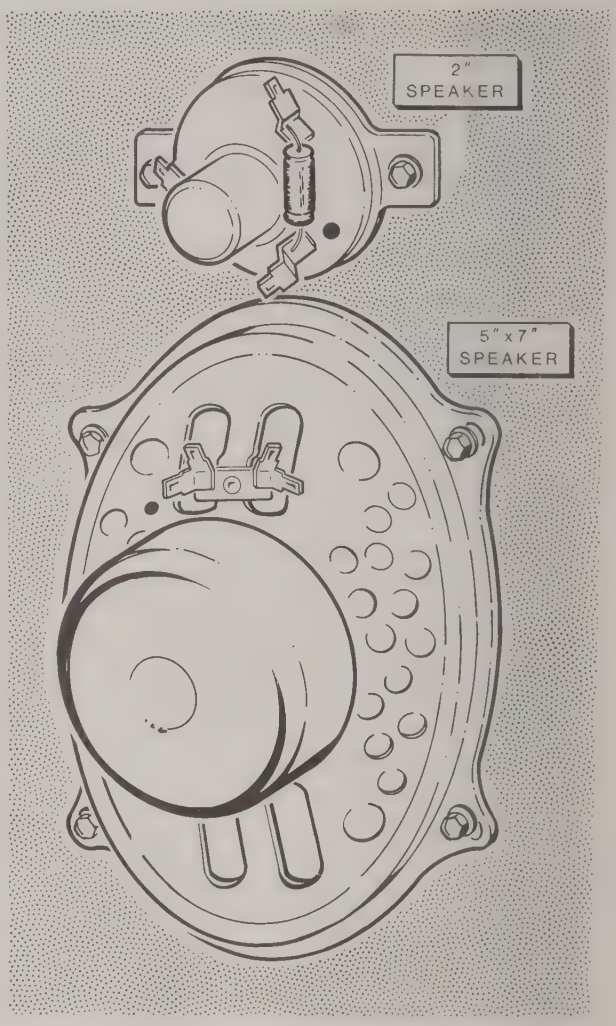
   ( ) Connector 8B4 to plug 8B4.

   ( ) Connector 8J4 to plug 8J4.

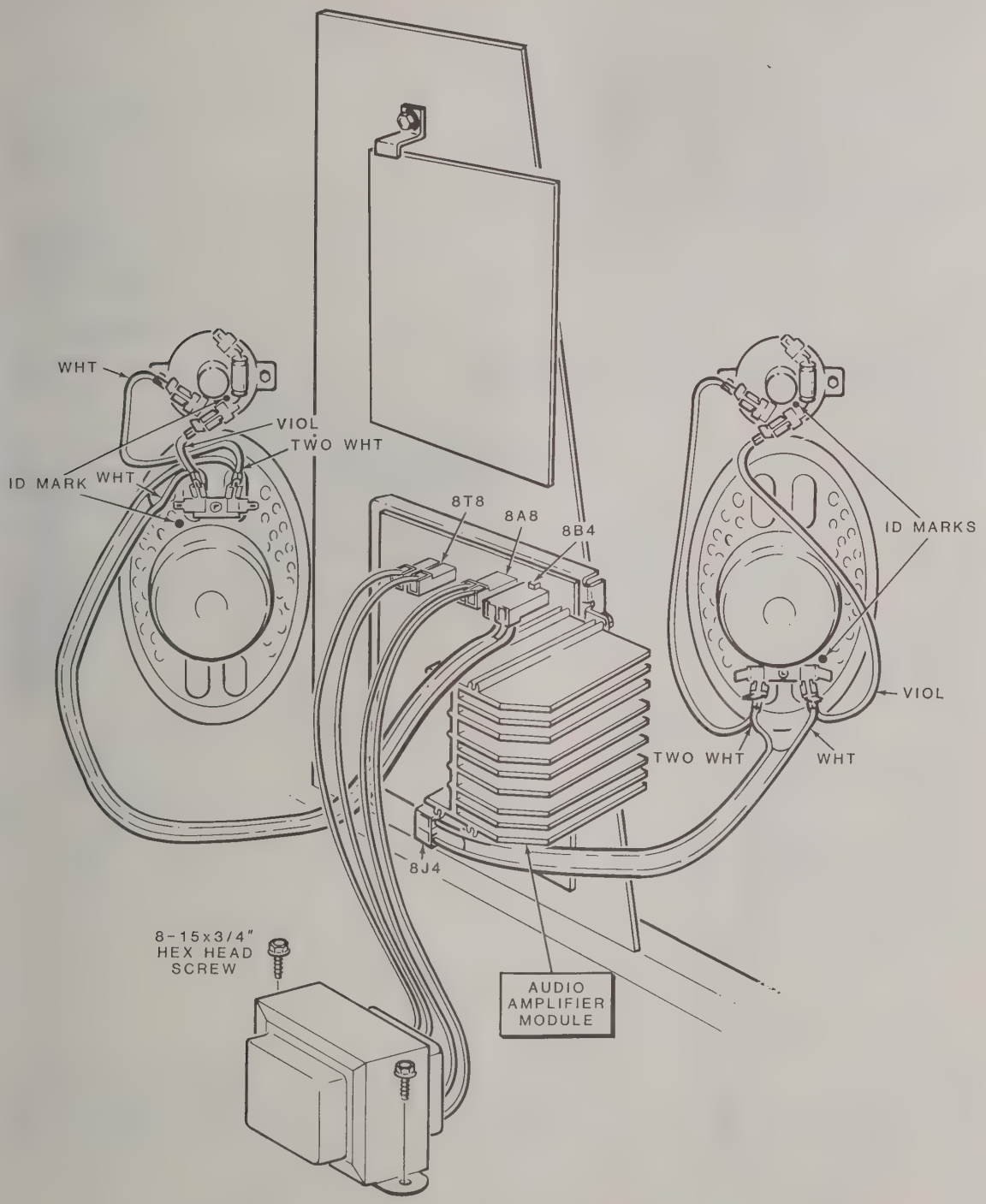
6. Mount the transformer w/leads 8A8 and 8T8 to the shelf with two 8-15 × 3/4" hex head screws.

   ( ) Connect power transformer connectors 8A8 and 8T8 to power amplifier plugs 8A8 and 8T8.

NOTE: If you were directed to this Manual from your Space Phone Accessory Manual, return to that Manual and complete the steps. Then return to Page 78 in this Manual.



Detail 3-9E

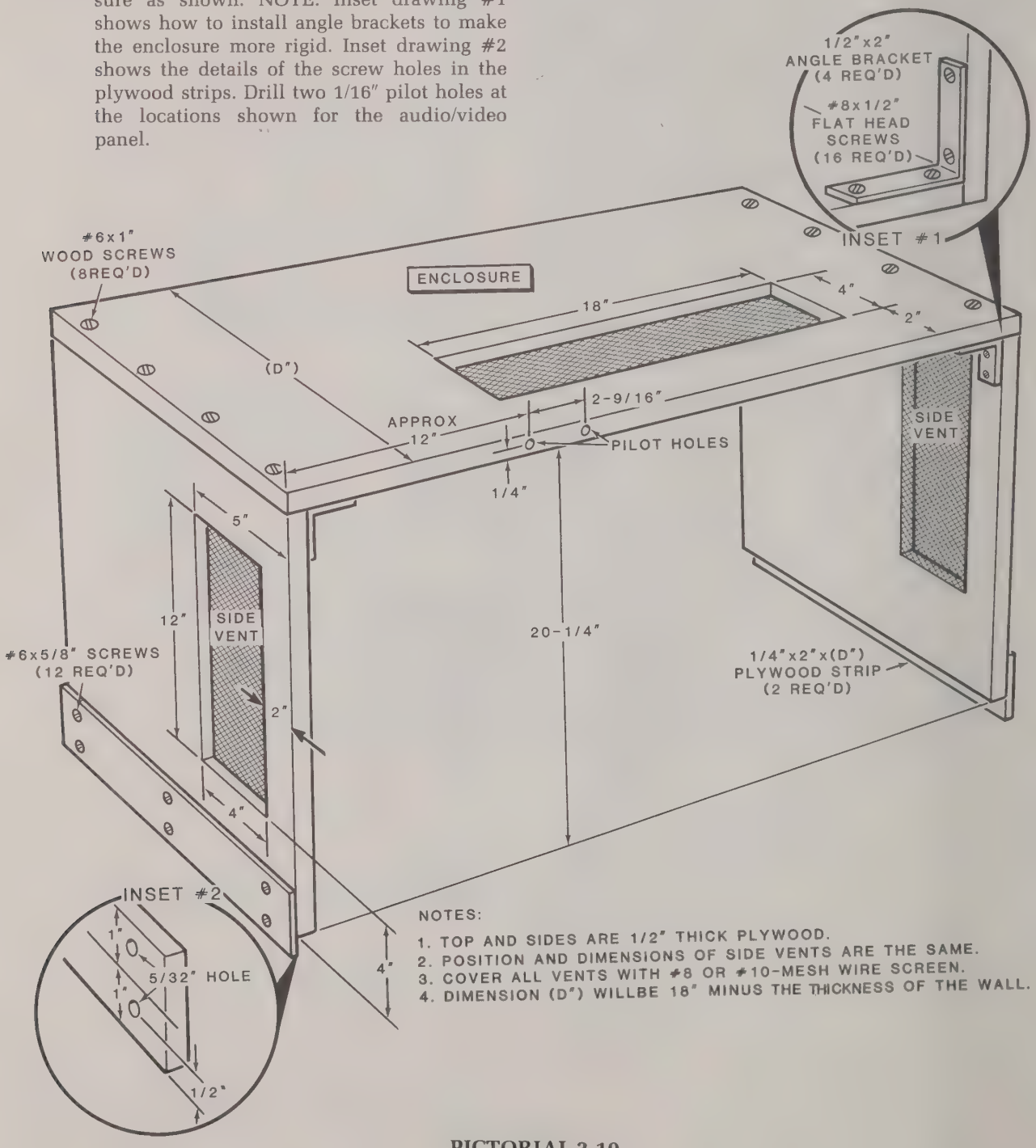

WHT
VIOL
TWO WHT
ID MARK WHT
8T8
8A8
8B4
ID MARKS
VIOL
TWO WHT
WHT
8J4
8-15x3/4"
HEX HEAD
SCREW
AUDIO
AMPLIFIER
MODULE

Detail 3-9F

PREPARING AND MOUNTING THE ENCLOSURE

1. Refer to Pictorial 3-10 and prepare the enclosure as shown. NOTE: Inset drawing #1 shows how to install angle brackets to make the enclosure more rigid. Inset drawing #2 shows the details of the screw holes in the plywood strips. Drill two 1/16" pilot holes at the locations shown for the audio/video panel.

2. Carefully place the completed enclosure over the TV Set and onto the shelf. Then secure it to each end of the shelf with three #6 × 5/8" screws.



NOTES:

1. TOP AND SIDES ARE 1/2" THICK PLYWOOD.
2. POSITION AND DIMENSIONS OF SIDE VENTS ARE THE SAME.
3. COVER ALL VENTS WITH #8 OR #10-MESH WIRE SCREEN.
4. DIMENSION (D") WILLBE 18" MINUS THE THICKNESS OF THE WALL.

PICTORIAL 3-10

PREPARING AND MOUNTING THE BACK PANEL

1. Refer to Pictorial 3-11 and, using 1/8″ thick pegboard, prepare a back panel. NOTE: Be sure you position the smooth side of the pegboard as shown before you start to prepare it.

2. Hold the prepared panel against the back of the enclosure. Then use two #6 × 5/8″ screws and temporarily mount the panel on the enclosure.

3. Place the audio/video panel in the cutout at the upper left corner of the panel. Mark the panel mounting hole locations; then remove the panel.

4. Mount the audio/video panel on the enclosure at the two pilot holes with two 8-15 × 3/4″ hex head screws.

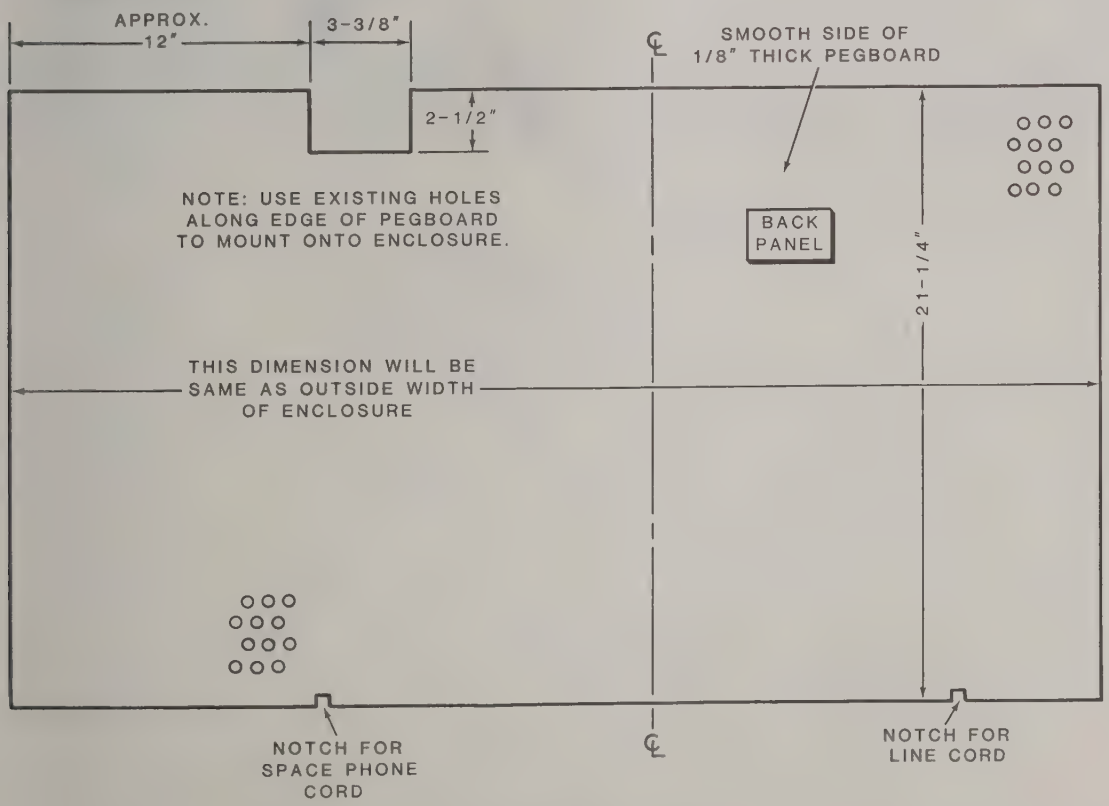
5. Route the line cord through the slot in the back panel. Then use #6 × 5/8″ screws in the appropriate pegboard holes and secure the back panel to the enclosure. Keep the line cord strain relief crimp inside the back panel.

6. Route the Space Phone cord (if installed) through the back panel slot.

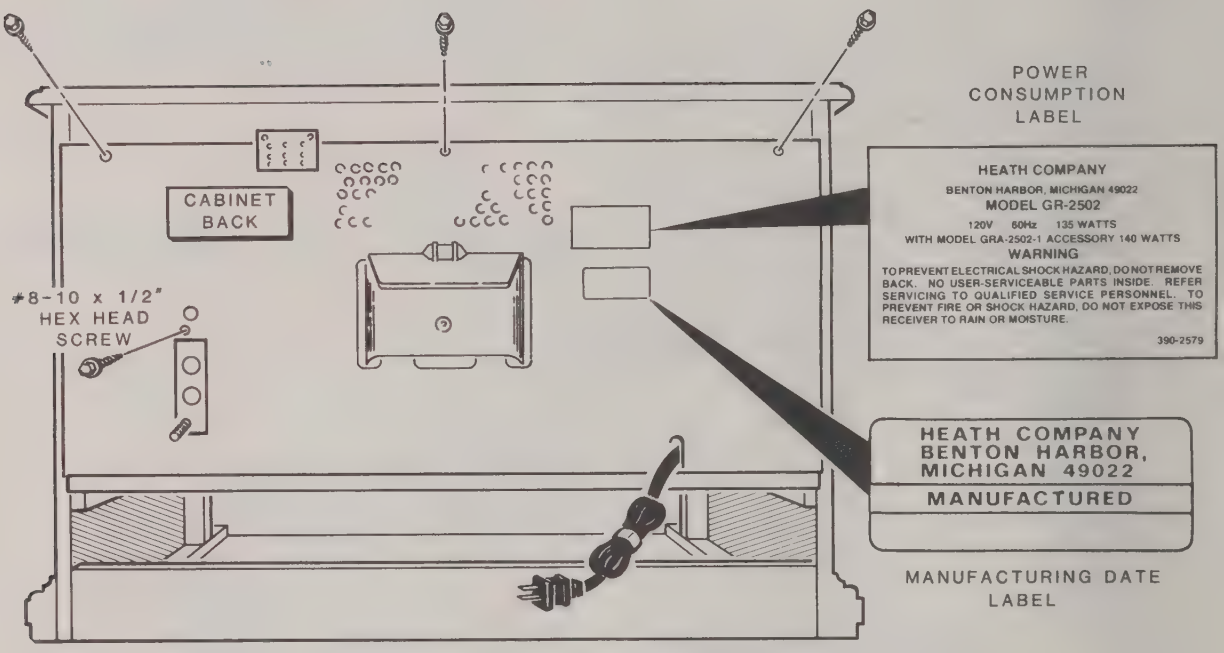
7. Remove the paper backing from a manufactured date label supplied with the Set, and press the label onto the back panel.

8. Similarly apply the power consumption label to the back panel.

This completes the "Custom Installation." Proceed to "Final Assembly" on Page 81.



PICTORIAL 3-11


CABINET BACK
#8-10 x 1/2" HEX HEAD SCREW
POWER CONSUMPTION LABEL
HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022
MODEL GR-2502
120V 60Hz 135 WATTS
WITH MODEL GRA-2502-1 ACCESSORY 140 WATTS
WARNING
TO PREVENT ELECTRICAL SHOCK HAZARD, DO NOT REMOVE BACK. NO USER-SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL. TO PREVENT FIRE OR SHOCK HAZARD, DO NOT EXPOSE THIS RECEIVER TO RAIN OR MOISTURE.
390-2579
HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022
MANUFACTURED
MANUFACTURING DATE LABEL

PICTORIAL 3-12

FINAL ASSEMBLY

Refer to Pictorial 3-12 for the following steps.

NOTE: If you custom installed your TV Set, skip the next three steps; otherwise, perform the steps.

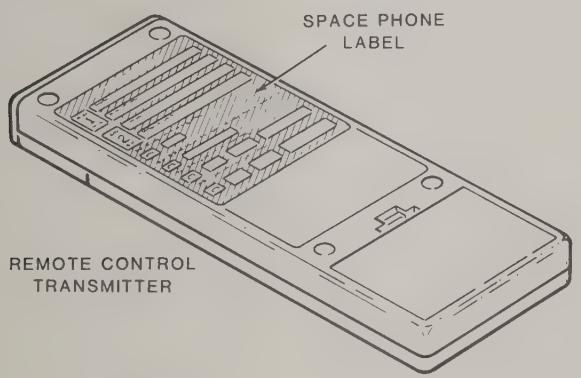
( ) Mount the cabinet back to the cabinet using the hardware you removed earlier.

( ) Remove the paper backing from the power consumption label and press the label on the cabinet back.

( ) Remove the backing from the manufacturing date label and press the label on the cabinet back at the indicated location.

( ) Refer to Pictorial 3-13 and remove the backing from the Space Phone label, located inside the remote control transmitter box. Install the label inside the raised area at the top rear of the transmitter.

This completes the "Final Assembly." Proceed to "Antennas" on Page 83.



PICTORIAL 3-13

ANTENNAS

This section will provide you with information concerning antennas, antenna lead-in (twin lead and shielded cable), proper antenna orientation, and signal preamplifiers for fringe areas. This information will help you select the proper antenna installation for maximum performance from your Color Television Set.

Your Color TV Set is designed to operate with one of the broadband types of antennas such as the inline types recommended for color TV reception. It is very important to use an antenna which is suited for your area. Some indoor and outdoor antennas that are used satisfactorily for black and white TV reception do not provide sufficient signal pickup and bandwidth for color television. The impedance of the antenna and the leads can be either 300 Ω or 75 Ω.

The connector coming through the back of the Set has an impedance of 75 Ω and connects to the tuner. If the cable coming from your antenna is 75 Ω, you can connect the cables directly to the connector. If the cable coming from your antenna is 300 Ω, you must use the 300 Ω to 75 Ω antenna balun supplied with your TV. The 300-ohm twin leads are then connected to their respective terminal screws.

ANTENNA LEAD-INS

INSTALLATION

Refer to Pictorial 4-1 for the following steps.

The color television signal is carried from the antenna to the Television Set by a length of 300 Ω twin lead or by a 75 Ω shielded (coaxial) cable. The most commonly used types of twin lead and shielded cable are listed, with a description of how they respond to weather conditions.

NOTE: Pictorial 4-1 Parts A and C shows how to connect 300 Ω twin lead to the antenna terminal assembly. Part A includes the indoor antenna twin-leads.

300 Ω Flat Twin Lead — Little signal loss in fair weather. High signal loss in wet weather, especially at UHF frequencies.

300 Ω Tubular Twin Lead — Little signal loss in fair weather. Less signal loss in wet weather than with flat twin lead. Better for UHF than flat twin lead.

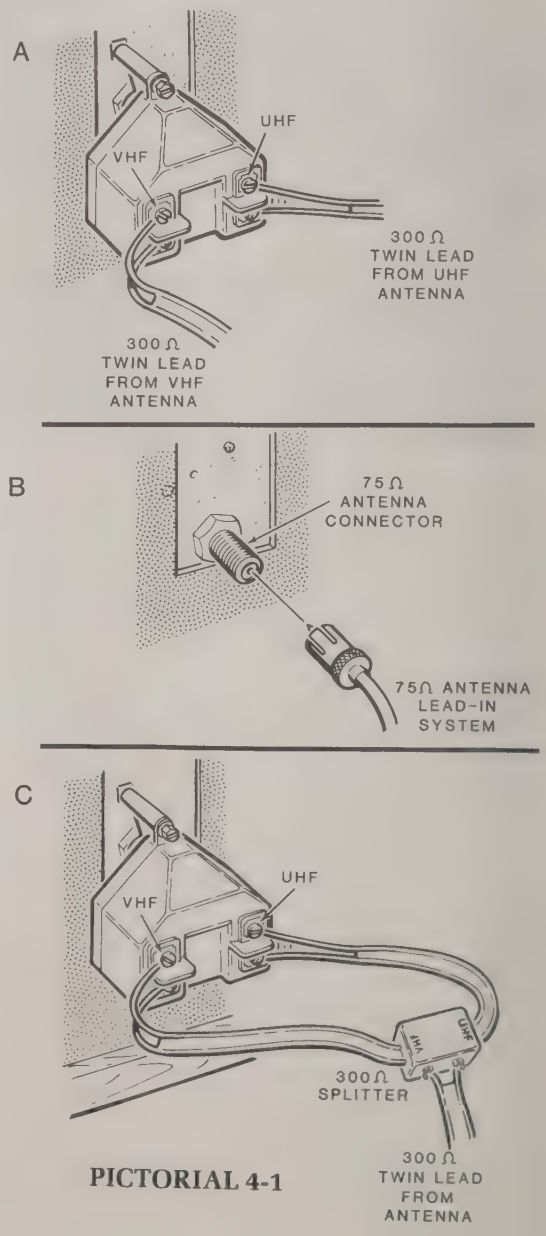
The signal loss may be even greater with the preceding two types of twin lead if they have accumulated a noticeable amount of foreign matter (dirt, chimney soot, etc.). Also, do not route these types of lead inside a metal pipe or within 5 inches of any metal surface.

75 Ω Low-Loss Shielded Cable — Slightly more signal loss in fair weather than the preceding two types of twin lead. However, it has the following advantages over twin lead: Very little signal loss in wet weather, less affected by local interference, lasts much longer, no stand off insulators needed to keep it away from antenna tower or pole, can be routed inside a metal pipe. Excellent for TV reception (color or black and white) and stereo-FM reception.

When a 75 Ω cable is used, a 75 Ω antenna should be used. If you have a single all channel, 75 Ω lead-in, connect it as shown in Part B of Pictorial 4-1.

CATV or Master Antenna Systems — The CATV antenna connection is shown in Pictorial 4-1 Part B. The UHF stations are converted to the unused VHF channels; therefore, UHF antenna connections are not used. Master antenna systems used in motels, hotels, and trailer parks are similar and use the same antenna connections.

300 Ω Twin Lead — This single lead-in requires a splitter and is connected as shown in Pictorial 4-1 Part C.



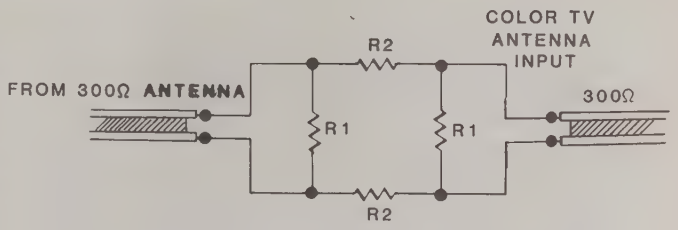
PICTORIAL 4-1

ANTENNA ORIENTATION

Antennas often need more careful orientation for good color TV reception than for black and white reception. Some antenna positions could result in good black and white pictures, but poor color pictures. This is mainly because the color information is transmitted differently than the black and white information. If a new antenna is being installed, or if the position of an older antenna seems questionable, orient it while you view a color program for best reception.

If the antenna is not oriented properly, signals from several directions may be reaching the antenna at the same time. These signals are usually reflected from objects such as large buildings or large metal structures. The reflected signals may cause slight phase shifts in the television signal. On black and white pictures, this would result in a very slight ghost (a duplicate image appearing next to the actual image) or smear. On color pictures, however, the phase shift can cause excessive color smear, ghosting and incorrect color areas. To eliminate this problem, rotate the antenna until the best picture is received.

Distorted pictures can sometimes be caused by too strong a signal, especially in metropolitan areas, where the transmitting antenna is quite close to the receiving antenna. In these cases, the signal from the antenna can be reduced by using an attenuator pad. Pictorial 4-2 shows two types of attenuator pads; one for 75 Ω antenna impedance and one for 300 Ω antenna impedance. Select the correct pad for your antenna impedance and connect it between the antenna and the Color TV Set, as shown. Resistors for making these pads can be obtained locally.

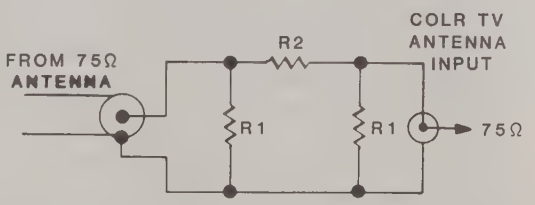


(RESISTORS ARE 1/2WATT COMPOSITION TYPE)

FOR A SMALL AMOUNT OF ATTENUATION (6 db)
R1 = 910Ω
R2 = 100Ω

FOR A MEDIUM AMOUNT OF ATTENUATION (12 db)
R1 = 510Ω
R2 = 270Ω

FOR A LARGE AMOUNT OF ATTENUATION (18 db)
R1 = 390Ω
R2 = 560Ω



(RESISTORS ARE 1/2 WATT COMPOSITION TYPE)

FOR A SMALL AMOUNT OF ATTENUATION (6db)
R1 = 220Ω
R2 = 56Ω

FOR A MEDIUM AMOUNT OF ATTENUATION (12 db)
R1 = 120Ω
R2 = 150Ω

FOR A LARGE AMOUNT OF ATTENUATION (18 db)
R1 = 100Ω
R2 = 300Ω

PICTORIAL 4-2

SIGNAL PREAMPLIFIERS

If you live in a fringe area where it is difficult to receive a strong TV signal, a preamplifier may be a solution to your problem. A preamplifier will amplify the weak signal received by the antenna. If you purchase a unit of this type, make sure the specifications qualify it to be used for color as well as black and white signals. If the bandpass specifications are too narrow, a phase shift could occur which could cause color smear and incorrect color areas (a black and white picture would not be affected).

There are two types of preamplifiers; outdoor and indoor.

The **outdoor** preamplifier is mounted on the antenna mast near the antenna. The antenna is connected to the input terminals, and the lead-in is connected to the output terminals. The other end of the lead-in is connected through the preamplifier power supply to the television antenna terminals. The power supply which supplies operating voltages for the preamplifier is mounted in the house, and the voltages are fed to the preamplifier through the lead-in.

The main advantage in using an outdoor preamplifier of this type is that only the TV signal from the antenna is amplified and not the noise picked up in the lead-in. This gives a better signal-to-noise ratio and less snow in the picture. In addition, very weak signals are amplified before they become attenuated by inherent line losses in the lead-in cables.

The **indoor** preamplifier is installed inside the house between the antenna and TV set. This unit amplifies the signal as well as the outdoor unit, however, any noise picked up in the lead-in is also amplified.

The indoor preamplifier is a good unit to use for couplers when more than one TV set is used. This type of unit can usually be purchased with more than one set of output terminals. Additional TV sets can be connected to these terminals. This would serve as an amplifier stage for each TV set, and also keep the sets from interfering with each other.

When using preamplifiers as multi-set couplers in strong signal areas, the input of the preamplifier (depending on the circuitry) may be overdriven. This would result in cross-modulation problems in the preamplifier and cause interference on one or more channels. Be sure to use an attenuator pad in these cases, such as the one shown in Pictorial 4-2, on the input of the preamplifier to reduce the amount of signal to the preamplifier.

NOTE: Many preamplifiers are more receptive to interference than the TV receiver because of their broad-band input. If your TV indicates interference, first disconnect the preamplifier and check the reception without it. If this eliminates the interference, an appropriate filter may be used in the lead-in going into the preamplifier from the antenna.

ANTENNA SWITCH

Four-position Antenna Switch Model GSZ-4600 is a special optional accessory for the GR-2502. This switch, which mounts on the rear of the TV Set, has four positions, labeled 1, 2, 3, and 4. Four signal sources can be attached to the switch including CATV and subscription TV converters/decoders, VCR, a video disc player, video games, and a home computer.

A key on the TV keyboard or the remote control transmitter steps through the four switch positions in sequence. The on-screen channel indicator is converted to an antenna switch position indicator. The word "ANTENNA" appears with the number of the switch position in use.

NOTE: The on-screen display will be visible whether the antenna switch is connected to the TV Set or not. This is normal.

OPERATION

WARNING: DO NOT EXPOSE THIS TV SET TO RAIN OR MOISTURE. NEVER OPERATE THE SET IF LIQUID HAS ACCIDENTLY SPILLED INTO IT. If this should happen, have your set checked by a qualified service technician before you use it again. Fire or electric shock could result.

NOTE: Be sure to read the "Television Safety Guide."

GENERAL

SELECTING THE LOCATION

Place your TV set where sunlight or bright light will not fall directly on the screen. Allow a comfortable viewing distance, usually six feet or more.

Be sure the location has access to a good antenna system. A good antenna is necessary to obtain the best possible color picture. Refer to the "Antennas" section of this Manual.

POWER SOURCE

Your TV Set is designed to operate on standard 120 volt, 60 Hertz AC. DO NOT ATTEMPT TO OPERATE YOUR SET ON DC. Refer to the information in the "Television Safety Guide" for more information.

SPECIAL PRECAUTIONS

Do not place antenna rotator controls, electric clocks, telephones, etc., on top of your Color TV set. These devices can produce undesirable magnetic effects that can distort the colors on the picture tube screen.

If you use your TV set to play video games, do not set the PICTURE control (brightness) for an excessively bright game display. A bright, fixed pattern such as "tennis court" lines, if used for long periods of time, may permanently imprint the pattern on the picture tube. To reduce this possibility, alternate your use of the game with normal TV viewing, turn the PICTURE control down when you play video games, and turn the game off promptly when you are finished.

If you do not intend to use the set for a long period of time (such as a vacation), we recommend that you unplug the line cord for added protection against possible damage from lightning or power surges. In addition, if your set is connected to an outside antenna, we recommend you disconnect the lead-in wires on the back of the set.

FRONT PANEL CONTROLS

Refer to Pictorial 5-1 (Illustration Booklet, Page 21) for the locations of the following controls on the front panel of your TV set.

COLOR SENTRY switch — Position this switch to Color Sentry to enable the light sensor, color signal monitor, tint stabilizer, color level lock, and contrast regulator circuits. These circuits work together to provide you with an excellent color picture automatically, scene to scene and channel to channel.

To make the Color Sentry give you the kind of picture you want, perform the following steps:

1. Push the POWER keypad to turn the Set on and allow it to warm up for two or three minutes.

2. Select a channel that is telecasting in color.

3. Be sure the COLOR SENTRY switch is in the Color Sentry position.

4. Turn the BLACK LEVEL control to the middle, or detent, position. This position usually assures you that the areas of the picture which should be black are black.

5. Turn the PICTURE control in either direction to get the brightness level you want.

6. If the dark areas of the picture and the colors appear faded or washed out, turn the BLACK LEVEL control counterclockwise. If light backgrounds and colors appear to be too dark, turn the control clockwise.

7. We recommend that you set the SHARPNESS control in the mid-range, or detent, position. If you prefer a softer picture, turn the control counterclockwise. For a sharper picture, turn the control clockwise.

8. If the color or tint still do not appeal to you when you have the COLOR SENTRY switch in the Color Sentry position, refer to "Color Sentry" on Page 68 and perform the adjustments that are outlined there.

9. With the COLOR SENTRY switch in the "Video Filter" position, the Color Sentry circuit will still be activated, but the picture sharpness will be slightly reduced.

The following paragraphs describe the action of each front panel control and switch and, where applicable, will describe its interaction with other controls and/or switches. For the best results from your TV, be sure you understand these control functions.

POWER keypad — Use this keypad to turn the TV Set on and off.

VOLUME UP (↑) keypad — Press and hold this keypad to increase the volume to the desired level. Continued pressure will increase the volume to maximum.

VOLUME DOWN (↓) keypad — Press and hold this keypad to reduce the volume to the desired level. Continued pressure will reduce the volume to minimum.

CHANNEL UP (↑) keypad — Press this keypad up to "up-scan" the programmed channels.

CHANNEL DOWN (↓) keypad — Press this keypad to "down-scan" the programmed channels.

0 THROUGH 9 CHANNEL keypads — Use these keypads to select the desired channel. To select a particular channel, simply push the numbered keypad(s) that match the desired channel number. The channel number will appear on the screen within two seconds. If you desire immediate channel selection, press the desired channel number and the ENTER/RECALL keypads.

CHANNEL RECALL (RCL) keypad — Use this keypad to recall the channel number and time display onto the screen.

ENTER/RECALL keypad — Use this keypad with the 0 through 9 keypads to select, or program, a channel immediately without the delay. Each channel selected this way will be programmed in the tuner control memory. You can also use this keypad to

recall the channel number and the time display on the screen.

SKIP keypad — Use the following procedure to skip (or program out) a channel from the scan sequence:

1. Press the numbered keypad(s) to select the channel you wish to skip. Then press the SKIP keypad to remove the channel from the memory in the TV Set. The letters CH PO (channel programmed out) will appear briefly along with the time. This will be followed by the channel number you have programmed out and the time.

2. Repeat step 1 for any other channels you wish to skip.

NOTE: You can reprogram any channel that was programmed out by following the instructions under "Enter/Recall." These channels cannot be reprogrammed through the remote control.

TIME RECALL (RCL) keypad — Use this keypad to recall the time display onto the screen. NOTE: The time will be indicated in the correct AM or PM by an A or a P. This keypad is normally only used with the time set keypads described next.

TIME (HR SET and MIN SET) keypads — Use these keypads to set the correct time. The first time you plug in your TV Set, or if there has been a power interruption, you will have to reset the clock. To set the correct time, first press the TIME RECALL (RCL) keypad. Then, while the time is still on the screen, press and hold the HR SET (hour) keypad until the correct hour is displayed (also the correct A or P for AM or PM).

Do the same thing with the MIN SET (minute) keypad until the correct minutes are displayed. NOTE: If the time display disappears while you are trying to set the time, simply press the TIME RECALL (RCL) keypad to recall the display. The time is not affected when you turn the TV Set off.

HI FILTER switch — In the ON position, this switch activates a filter which removes high frequency noise (hiss) from the sound. It may also remove some of the desired high frequency audio. This filter is bypassed in the OFF position.

AUDIO SOURCE switch — In the up position, the L and R STEREO INPUT jacks on the audio/video panel, are activated. In the down position, this switch selects normal TV sound.

NOTE: To enable the AUDIO INPUT jack, you must have the AUDIO SOURCE switch in the "TV" position and the VIDEO SOURCE switch in the "Aux" position. You must also have a video signal applied to the video input jack. The input/output jack and switch operation chart is shown below.

VIDEO SOURCE switch — In the up position, the VIDEO INPUT jack on the audio/video panel is activated. In the down position, the normal TV picture is selected.

MANUAL-REMOTE switch — Use this switch to enable and disable remote control operation. In the MANUAL position, you can only control the TV Set from the front panel. In the REMOTE position, you can control the TV Set from either the front panel or the Remote Control.

OPERATION	AUDIO SOURCE SWITCH	VIDEO SOURCE SWITCH
AUDIO IN	TV	AUX
VIDEO IN	—	AUX
STEREO IN	AUX STEREO	—
AUDIO OUT	—	TV
VIDEO OUT	—	TV

BAND SELECTOR switch — Refer to Table 5-1 for the correct setting of this switch. In the CATV position, the TV Set is capable of receiving the special cable TV channels that are located between the ordinary channels.

Since this TV Set has a maximum of 178 CATV channels, only channels 00 through 120 are valid. These channels are designated by the cable TV industry as channels 2 through 13, A-2, A-1, A through W, and AA through ZZ. Therefore, to select the lettered channels, you must interpolate them to a numbered channel. Table 5-2 is provided so you can easily keep track of these cable TV channels, which are provided by your CATV company. Refer to the "U.S. TV Frequencies" charts on Pages 94 through 97.

AFC switch — Refer again to Table 5-1 for the correct setting of this switch. Normally, you will keep this switch in the NORM position. If the signals your Set is receiving vary from FCC standard frequencies, you may get poor reception or no picture. This condition is most prevalent when you use a CATV (cable antenna), an MATV (master antenna), or some types of video games. If you experience poor reception when you use one of these sources, slide the switch to the SPCL (Special) position and recheck your reception.

ANTENNA buttons select one of four antenna inputs when the antenna switch accessory is used. When this accessory is not used, selecting any antenna will have no effect on your reception. But the antenna number display will be shown on the screen.

PICTURE (brightness) control — Use this control to adjust the picture brightness to the desired level. This control automatically adjusts the contrast and color level to the proper balance.

BLACK LEVEL control — Use this control to set the black areas of the picture to the desired level. Once you have this control properly set, an electronic contrast regulator automatically maintains this preset black level from scene to scene. Use the PICTURE control to make any further brightness adjustments.

COLOR LEVEL control — Use this control to change the intensity of the colors. If the colors appear faded or weak, turn the control clockwise. If the colors appear vivid or intense (see Photo C, fold-in) turn the control counterclockwise. This control has no effect when the Color Sentry switch is on.

TINT control — Use this control to adjust the picture for the most natural flesh tones. If the flesh tones appear purple (see Photo D), turn the control clockwise. If the flesh tones appear green (see Photo E), turn the control counterclockwise. This control has no effect when the Color Sentry switch is on.

SHARPNESS control — Use this control to adjust the detail in the picture. Turn the control counterclockwise for a softer picture. For more detail, turn the control clockwise.

BASS CONTROL

This control varies the low frequency response of both channels simultaneously. When you rotate the control from its center (detent) position, a clockwise rotation increases and a counterclockwise rotation decreases the bass levels.

TREBLE CONTROL

This control varies the high frequency response of both channels simultaneously. When you rotate the control from its center (detent) position, a clockwise rotation increases and a counterclockwise rotation decreases the high frequency levels.

BALANCE CONTROL

This control adjusts the left or right channel amplifiers so there is equal sound from the left and right channel speakers.

VHF/UHF CATV BAND	AFC NORM SPCL	
YOUR TV SIGNAL	**BAND SELECTOR SWITCH**	**AFT SWITCH**
INDOOR OR OUTDOOR ANTENNA	NORM	NORM
CABLE ANTENNA SYSTEM (CATV)	CATV	NORM OR SPCL*
MASTER ANTENNA SYSTEM (MA TV)	NORM	NORM OR SPCL*
VIDEO GAMES	NORM	SPCL

*Refer to "AFC switch" for more information.

Table 5-1

CATV (VHF) Channel	2	3	4	5	6	7	8	9	10	11	12	13
Select Channel Number	2	3	4	5	6	7	8	9	10	11	12	13
Actual TV Station**	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

CATV (Midband) Channel	A-2	A-1	A	B	C	D	E	F	G	H	I
Select Channel Number	0	1	14	15	16	17	18	19	20	21	22
Actual TV Station**	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

CATV (Superband) Channel	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Select Channel Number	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Actual TV Station**	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

CATV (Hyperband) Channel	AA	BB	CC	DD	EE	FF	GG	HH	II	JJ	KK	LL	MM	NN
Select Channel Number	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Actual TV Station**	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	OO	PP	QQ	RR	SS	TT	UU	VV	WW	XX	YY	ZZ		
	51	52	53	54	55	56	57	58	59	60	61	62	63	64
	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

CATV (Ultraband) Channel														
Select Channel Number	65	66	67	68	69	70	71	72	73	74	57	76	77	78
Actual TV Station**	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	79	80	81	82	83	84	85	86	87	88	89	90	91	92
	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	93	94	95	96	97	98	99	100	101	102	103	104	105	106
	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	107	108	109	110	111	112	113	114	115	116	117	118	119	120
	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

** You may write in the actual station name or channel information supplied by your cable TV (CATV) company.

Table 5-2

U.S. TV FREQUENCIES

CHANNEL	SELECTION NO.	BAND	VIDEO CARRIER	SOUND CARRIER	OSC. FREQ.
		LOW BAND VHF			
2	2	54- 60	55.25	59.75	101
3	3	60- 66	61.25	65.75	107
4	4	66- 72	67.25	71.75	113
—	00	70.75-76.75	72.00	76.50	117.75
5	5	76- 82	77.25	81.75	123
6	6	82- 88	83.25	87.75	129
		MID BAND CATV			
A-2	0	108-114	109.25	113.75	155
A-1	1	114-120	115.25	119.75	161
A	14	120-126	121.25	125.75	167
B	15	126-132	127.25	131.75	173
C	16	132-138	133.25	137.75	179
D	17	138-144	139.25	143.75	185
E	18	144-150	145.25	149.75	191
F	19	150-156	151.25	155.75	197
G	20	156-162	157.25	161.75	203
H	21	162-168	163.25	167.75	209
I	22	168-174	169.25	173.75	215
		HIGH BAND VHF			
7	7	174-180	175.25	179.75	221
8	8	180-186	181.25	185.75	227
9	9	196-192	187.25	191.75	233
10	10	192-198	193.25	197.75	239
11	11	198-204	199.25	203.75	245
12	12	204-210	205.25	209.75	251
13	13	210-216	211.25	215.75	257
		SUPERBAND CATV			
J	23	216-222	217.25	221.75	263
K	24	222-228	223.25	227.75	269
L	25	228-234	229.25	233.75	275
M	26	234-240	235.25	239.75	281
N	27	240-246	241.25	245.75	287
O	28	246-252	247.25	251.75	293
P	29	252-258	253.25	257.75	299
Q	30	258-264	259.25	263.75	305
R	31	264-270	265.25	269.75	311
S	32	270-276	271.25	275.75	317
T	33	276-282	277.25	281.75	323
U	34	282-288	283.25	287.75	329
V	35	288-294	289.25	293.75	335
W	36	294-300	295.25	298.75	341
		HYPERBAND CATV			
AA	37	300-306	301.25	305.75	347
BB	38	306-312	307.25	311.75	353
CC	39	312-318	313.25	317.75	359
DD	40	318-324	319.25	323.75	365
EE	41	324-330	325.25	329.75	371
FF	42	330-336	331.25	335.75	377
GG	43	336-342	337.25	341.75	383

U.S. TV Frequencies (Cont'd)

CHANNEL	SELECTION NO.	BAND	VIDEO CARRIER	SOUND CARRIER	OSC. FREQ.
HH	44	342-348	343.25	347.75	389
II	45	348-354	349.25	353.75	395
JJ	46	354-360	355.25	359.75	401
KK	47	360-366	361.25	365.75	407
LL	48	366-372	367.25	371.75	413
MM	49	372-378	373.25	377.75	419
NN	50	378-384	379.25	383.75	425
OO	51	384-390	385.25	389.75	431
PP	52	390-396	391.25	395.75	437
QQ	53	396-402	397.25	401.75	443
RR	54	402-408	403.25	407.75	449
SS	55	408-414	409.25	413.75	455
TT	56	414-420	415.25	419.75	461
UU	57	420-426	421.25	425.75	467
VV	58	426-432	427.25	431.75	473
WW	59	432-438	433.25	437.75	479
XX	60	438-444	439.25	443.75	485
YY	61	444-450	445.25	449.75	491
ZZ	62	450-456	451.25	455.75	497
—	63	456-462	457.25	461.75	503
—	64	462-468	463.25	467.75	509
		ULTRABAND CATV			
	65	468-474	469.25	473.75	515
	66	474-480	475.25	479.75	521
	67	480-486	481.25	485.75	527
	68	486-492	487.25	491.75	533
	69	492-498	493.25	497.75	539
	70	498-504	499.25	503.75	545
	71	504-510	505.25	509.75	551
	72	510-516	511.25	515.75	557
	73	516-522	517.25	521.75	563
	74	522-528	523.25	527.75	569
	75	528-534	529.25	533.75	575
	76	534-540	535.25	539.75	581
	77	540-546	541.25	545.75	587
	78	546-552	547.25	551.75	593
	79	552-558	553.25	557.75	599
	80	558-564	559.25	563.75	605
	81	564-570	565.25	569.75	611
	82	570-576	571.25	575.75	617
	83	576-582	577.25	581.75	623
	84	582-588	583.25	587.75	629
	85	588-594	589.25	593.75	635
	86	594-600	595.25	599.75	641
	87	600-606	601.25	605.75	647
	88	606-612	607.25	611.75	653
	89	612-618	613.25	617.75	659
	90	618-624	619.25	623.75	665

U.S. TV Frequencies (Cont'd)

CHANNEL	SELECTION NO.	BAND	VIDEO CARRIER	SOUND CARRIER	OSC. FREQ.
	91	624-630	625.25	629.75	671
	92	630-636	631.25	635.75	677
	93	636-642	637.25	641.75	683
	94	642-648	643.25	647.75	689
	95	648-654	649.25	653.75	695
	96	654-660	655.25	659.75	701
	97	660-666	661.25	665.75	707
	98	666-672	667.25	671.75	713
	99	672-678	673.25	677.75	719
	100	678-684	679.25	683.75	725
	101	684-690	685.25	689.75	731
	102	690-696	691.25	695.75	737
	103	696-702	697.25	701.75	743
	104	702-708	703.25	707.75	749
	105	708-714	709.25	713.75	755
	106	714-720	715.25	719.75	761
	107	720-726	721.25	725.75	767
	108	726-732	727.25	731.75	773
	109	732-738	733.25	737.75	779
	110	738-744	739.25	743.75	785
	111	744-750	745.25	749.75	791
	112	750-756	751.25	755.75	797
	113	756-762	757.25	761.75	803
	114	762-768	763.25	767.75	809
	115	768-774	469.25	773.75	815
	116	774-780	775.25	779.75	821
	117	780-786	781.25	785.75	827
	118	786-792	787.25	791.75	833
	119	792-798	793.25	797.75	839
	120	798-804	799.25	803.75	845
		UHF BAND			
14	14	470-476	471.25	475.75	517
15	15	476-482	477.25	481.75	523
16	16	482-488	483.25	487.75	529
17	17	488-494	489.25	493.75	535
18	18	494-500	495.25	499.75	541
19	19	500-506	501.25	505.75	547
20	20	506-512	507.25	511.75	553
21	21	512-518	513.25	517.75	559
22	22	518-524	519.25	523.75	565
23	23	524-530	525.25	529.75	571
24	24	530-536	531.25	535.75	577
25	25	536-542	537.25	541.75	583

U.S. TV Frequencies (Cont'd)

CHANNEL	SELECTION NO.	BAND	VIDEO CARRIER	SOUND CARRIER	OSC. FREQ.
26	26	542-548	543.25	547.75	589
27	27	548-554	549.25	553.75	595
28	28	554-560	555.25	559.75	601
29	29	560-566	561.25	565.75	607
30	30	566-572	567.25	571.75	613
31	31	572-578	573.25	577.75	619
32	32	578-584	579.25	583.75	625
33	33	584-590	585.25	589.75	631
34	34	590-596	591.25	595.75	637
35	35	596-602	597.25	601.75	643
36	36	602-608	603.25	607.75	649
37	37	608-614	609.25	613.75	655
38	38	614-620	615.25	619.75	661
39	39	620-626	621.25	625.75	667
40	40	626-632	627.25	631.75	673
41	41	632-638	633.25	637.75	679
42	42	638-644	639.25	643.75	685
43	43	644-650	645.25	649.75	691
44	44	650-656	651.25	655.75	697
45	45	656-662	657.25	661.75	703
46	46	662-668	663.25	667.75	709
47	47	668-674	669.25	673.75	715
48	48	674-680	675.25	679.75	721
49	49	680-686	681.25	685.75	727
50	50	686-692	687.25	691.75	733
51	51	692-698	693.25	697.75	739
52	52	698-704	699.25	703.75	745
53	53	704-710	705.25	709.75	751
54	54	710-716	711.25	715.75	757
55	55	716-722	717.25	721.75	763
56	56	722-728	723.25	727.75	769
57	57	728-734	729.25	733.75	775
58	58	734-740	735.25	739.75	781
59	59	740-746	741.25	745.75	787
60	60	746-752	747.25	751.75	793
61	61	752-758	753.25	757.75	799
62	62	758-764	759.25	763.75	805
63	63	764-770	765.25	769.75	811
64	64	770-776	771.25	775.75	817
65	65	776-782	777.25	781.75	823
66	66	782-788	783.25	787.75	829
67	67	788-794	789.25	793.75	835
68	68	794-800	795.25	799.75	841
69	69	800-806	801.25	805.75	847

REMOTE CONTROL

Refer to Pictorial 5-2 (Illustration Booklet, Page 21) for the locations of the pushbuttons on the Remote Control.

NOTE: Most of the pushbuttons on the Remote Control are self-explanatory and operate similarly to their counterparts on the front panel of the TV set. Only those pushbuttons that do not appear on the front panel are described below.

CHANNEL SELECTION pushbuttons — These pushbuttons also allow you to place a telephone call through your TV Set if you have the Space Phone® Accessory. See your Space Phone® Manual for more information.

SPACEPHONE pushbutton — Use this pushbutton to answer or place a telephone call. NOTE: This pushbutton is functional only if you have the Space Phone® Accessory.

MUTE/PRIVACY pushbutton — Use this pushbutton to turn the TV sound off and on. It will also disable the outgoing sound during a telephone call if you have the Space Phone® Accessory. This allows you to have a private in-room conversation without turning off the caller's voice.

AUTO DIAL pushbutton — Use this pushbutton to automatically dial a phone number when you have the Space Phone accessory.

NOTE: Your remote control uses a "J" size 6 volt alkaline battery. This battery will last three to four years under normal use.

SPECIAL NOTE — You can select any TV channel with the Remote Control. These channels, however, do not enter the TV set's memory. You can program channels into memory only through the front panel keyboard.

REAR PANEL CONNECTIONS

NOTE: Refer to the "Antennas" section of this Manual for information concerning the antenna connections.

Refer to Pictorials 5-3 and 5-4 (Illustration Booklet, Page 21).

REDI-PLUG and IF OUTPUT — Provides an IF output provision to add external accessories.

Audio/Video Panel — With the front panel AUDIO SOURCE switch in the "TV" position and the VIDEO SOURCE switch in the AUX position, you can operate any VCR (video cassette recorder), video disc player, or TV game through the AUDIO INPUT and VIDEO INPUT jacks on this panel. In this position, both sets of speakers will operate simultaneously (mono). Use 75 Ω shielded cable for all video interconnections and audio shielded cable for all audio interconnections.

With the AUDIO SOURCE front panel switch in the AUX STEREO position, you can operate a stereo receiver through your TV speakers using the L and R STEREO INPUT jacks. The speakers will operate in stereo.

NOTE: To enable the audio input jack, you must have the AUDIO SOURCE switch in the "TV" position, and the VIDEO SOURCE switch in the "AUX" position. Also, you must have a video signal applied to the VIDEO INPUT jack.

DIRECT VCR OPERATION

The VIDEO OUTPUT and AUDIO OUTPUT jacks are active whenever the AUDIO SOURCE and VIDEO SOURCE switches are in the TV (down) position. You can use these outputs for recording with your VCR.

The VIDEO and AUDIO INPUT/OUTPUT connections on the GR-2502 TV may be connected to the appropriate video and audio input/output connections (on recorders so equipped) to enable recording and playback directly without routing the programs through the antenna connection of the TV.

To record a program directly from the TV, simply connect shielded cables from the TV's Video and Audio Output Connectors to the tape recorder's video and audio inputs. Select the desired TV channel and use the tape recorder in its "Record" mode. Settings of the TV's VOLUME, CONTRAST, BRIGHTNESS, COLOR, and TINT controls will have no effect on the recording being made.

To play the recording back, connect shielded cables from the tape recorder's video and audio outputs to the respective TV inputs. Place the TV's VIDEO SOURCE switch to the "AUX" position. All the TV's control panel adjustments will operate normally during playback, except for the channel selection.

NOTE: This method of recording will not allow you to view one channel while recording another.

The video and audio cable connections to the recorder must be disconnected whenever the antenna connection is made through the recorder. With some recorders, a "loop" effect will result in loss of picture and squealing in the sound due to simultaneous signal paths. Consult the recorder's instruction booklet for a solution to problems which you may encounter.

SERVICEMAN WARNING — X-RADIATION PRECAUTION

The only potential source of X-radiation in this television receiver is the picture tube. The picture tube is constructed of materials which reduce X-ray radiation. This tube will not emit X-rays when the high voltage is at the factory specified level. Refer to the X-ray Precaution Label located inside the television receiver for the correct high voltage.

If the CRT anode connector requires replacement, the entire power supply module must be returned to the factory for service.

IN CASE OF DIFFICULTY

Begin your search for any trouble that occurs after assembly by carefully following the steps listed below under "Visual Tests." After you complete the "Visual Tests," refer to the Troubleshooting Charts. Start at the first Chart and locate the first condition that best describes the problem you observe. Then perform the tests listed under that condition to determine which module is most likely at fault. When you determine which module is suspected to be faulty, we recommend that you return the module to either the factory or one of the Heath Electronic Centers for exchange. Refer to "Service Facilities" Page 121 for more information.

VISUAL TESTS

1. Recheck the wiring. Trace each lead with a colored pencil on the Pictorial as you check it. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something that you have consistently overlooked.

2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor soldering. Therefore, you can eliminate many troubles by reheating all of your connections to make sure they are soldered as described on Pages 13 and 14. Be sure there are no solder "bridges" between circuit board foils.

3. Check to be sure all transistors and diodes are in their proper locations. Make sure each lead is connected to the proper point. Make sure that each diode band is positioned above the band printed on the circuit board or as directed in its step.

4. Check electrolytic and tantalum capacitors to be sure their positive (+) or negative (−) mark is at the correct location.

5. Check to be sure that each IC is properly installed in its socket, and that the pins are not bent out or under the IC. Also be sure the IC's are installed in their correct positions.

6. Check the values of the parts. Be sure in each step that you wired the correct part into the circuit, as shown in the Pictorial. It would be easy, for example, to install a 22 kΩ (red-red-orange) resistor where a 2200 Ω (red-red-red) resistor should have been installed. Refer to the "Circuit Board X-Ray Views" (Illustration Booklet, Pages 48 through 53) for the physical location of parts on the circuit boards.

7. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

8. Look between each circuit board and the chassis to be sure all leads were cut off short.

9. A review of the "Circuit Description" may also help determine where the trouble is.

   If you have still not located the trouble after the "Visual Tests" are completed, and a voltmeter is available, check voltage readings against those shown on the Schematic Diagrams. Read "Precautions for Troubleshooting" before you make any measurements. NOTE: All voltage readings were taken with a high input impedance voltmeter. DC voltages and resistances may vary as much as ±20%. AC voltages may vary much more depending upon the meter and the way you have the leads connected. NOTE: The readings indicated in the test charts were taken with a Heathkit Model IM-5217 VOM.

Waveforms are shown on the Schematic Diagrams, Pages 34, 35 and 39 of the Illustration Booklet, for reference.

PRECAUTIONS FOR TROUBLESHOOTING

Always place the Manual/Remote slide switch, on the front panel, in the Manual position before you troubleshoot your TV Set. This disables the remote control circuitry.

Be sure you do not short any terminals to ground when you make voltage measurements. If the probe should slip, for example, and short across components or voltage sources, it is very likely to cause damage to one or more transistors or diodes.

In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of this Manual. Your Warranty is inside the front cover.

NOTE: The horizontal shutdown circuitry may be activated during troubleshooting procedures. To restart it, unplug the line cord momentarily and then plug it back in.

TROUBLESHOOTING CHARTS

The following charts list the "Condition" and "Possible Cause" of some possible malfunctions. Under some of the conditions you will find several tests you can make. These tests should help you narrow down the problem to a specific area or, in some cases, a specific part. If a particular part or parts are mentioned (transistor Q2504, for example, or connector 4B4 pin 5) as a possible cause, check these parts to see if they are wired or installed incorrectly. Also check to see if an improper part was installed at that location. It is also possible, on rare occasions, for a part to be faulty.

NOTES:

1. When you are directed to make an ohmmeter measurement, be sure to unplug the line cord of the TV set. Also, we recommend that you unplug the line cord whenever you connect or disconnect the voltmeter.

2. Since several circuit board "modules" are involved in some of the troubleshooting tests, the Pictorial numbers will not be called out each time. The modules will be referred to by name and will correspond to the following Pictorials:

   Overall TV set ..... Pictorial 6-1
   (Illustration Booklet, Page 22)

   Control assembly ..... Pictorial 6-2
   (Illustration Booklet, Page 23)

   Tuner Control module ..... Pictorial 6-3
   (Illustration Booklet, Page 23)

   Infrared Sensor assembly .... Pictorial 6-4
   (Illustration Booklet, Page 23)

   UHF/VHF Tuner ..... Pictorial 6-5
   (Illustration Booklet, Page 23)

   CRT Socket module ..... Pictorial 6-6
   (Illustration Booklet, Page 23)

   Main module ..... Pictorial 6-7
   (Illustration Booklet, Page 24)

   Sweep module ..... Pictorial 6-8
   (Illustration Booklet, Page 24)

   Power Supply assembly ..... Pictorial 6-9
   (Illustration Booklet, Page 25)

   Crosshatch ..... Pictorial 6-10
   (Illustration Booklet, Page 26)

   Remote Transmitter ..... Pictorial 6-11
   (Illustration Booklet, Page 26)

   Audio/Video Input/Output module
   ..... Pictorial 6-12
   (Illustration Booklet, Page 26)

   Amplifier module ..... Pictorial 6-13
   (Illustration Booklet, Page 26)

   Keyboard . . . (Illustration Booklet, Page 44)

3. To use the following charts, first find the condition that best describes your TV's symptoms. Then perform each numbered test under that symptom. When you find a test that does not produce the indicated results, refer to the items listed under "Possible Cause."

NOTE: This TV Set has two separate ground systems. Unless you are directed otherwise, all measurements are made between the point indicated and chassis ground at either of the two clip leads on the adapter mounting bracket.

CAUTION: Do not connect anything to the sweep module heat sink since there is voltage present on it.

Troubleshooting Charts (Cont'd.)

CONDITION	TEST	POSSIBLE CAUSE
Receiver does not come on. No clicking sound from relay KX6401 when you press the OFF/ON pushbutton on the front panel.		
	1. Unplug the line cord from the power supply assembly. Measure the resistance between connector 6S3 pins 1 and 2 on the tuning module. You should measure 70 Ω.	A. Remote Control transformer T1. B. Wiring of remote control transformer T1. C. Open connection at connector 6S3.
	2. Measure the resistance between connectors 6S3 pin 1 and 6R3 pin 2 on the tuning module. You should measure 15 Ω.	A. Fuse FX6401. B. Open connection at connectors 6S3 pin 1 or 6R3 pin 2.
	3. Measure the resistance between terminal strip TS1 lugs 2 and 1. You should measure 86 Ω.	A. Open connection at connectors 6R3 pin 1 or 6S3 pin 2.
	4. Measure the resistance between terminal strip TS1 lug 1 and the line cord prong next to the ribbed lead. You should measure 0 Ω.	A. Wiring in power supply assembly. B. Line cord.
	5. Measure the resistance between terminal strip TS1 lug 2 and the line cord prong next to the smooth lead. You should measure 0 Ω.	A. Fuse FX301. B. Wiring in the power supply assembly. C. Line cord.
	6. Plug in the line cord. Then measure the voltage at connector 6M1 pin 5 on the tuner control module. You should measure 5 volts DC.	A. Problem on tuner control module.

Troubleshooting Charts (Cont'd.)

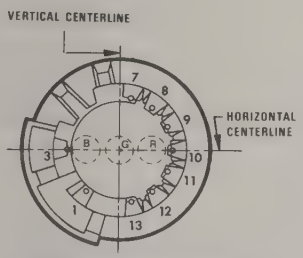
CONDITION	TEST	POSSIBLE CAUSE
Receiver does not come on. You can hear a clicking sound from relay KX6401 when you press the POWER pushbutton on the front panel.		
	NOTE: Use caution when you make the following tests or you could be exposed to a hazardous electrical shock. Connectors 6R3 and 6S3 on the tuner control module and terminal strip TS1 on the power supply assembly are connected directly to the AC line. Be sure to unplug the line cord while you connect the meter leads.	
	1. Measure the voltage between connector 6R3 pin 1 and 2 on the tuner control module. You should measure 120 volts AC.	A. Open connector at connector 6R3 pin 3. B. Problem on the tuner control module.
	2. Measure the voltage between terminal strip TS2 lugs 1 and 2 on the power supply assembly. You should measure 120 volts AC.	A. Open connection from connector 6R3 pin 3. B. Open connection at terminal strip TS2 lugs 2 or 4.
	3. Measure the voltage between connector 3R8 pins 1 and 3 on the main module. You should measure 120 volts AC.	A. Transformer TX301. B. Incorrectly wired power transformer.
	4. Unplug connector 3R8 from the main module. Then measure the resistance between connector 3S8 pin 2 and connector 3R8 pin 1. You should measure 0 Ω.	A. Fuse FX3299. B. Connector 3S8 or 3R8 not making proper contact. C. Resistor R3250.
	5. Reconnect connector 3R8. Then measure the voltage between the anode (unbanded lead) of diode CR3274 and the cathode (banded lead) of diode CR3273 on the main module. You should measure 150 volts DC. NOTE: CR3273 and CR3274 may be screened CRX3273 and CRX3274.	A. Problem on the sweep module.
	6. Place the Manual/Remote slide switch on the front panel in the Remote position. Then push the POWER pushbutton on the remote transmitter several times. You should hear the relay on the tuner control module click each time.	A. Open connection between slide switch and connector 6D6 pin 3 on the tuner control module.

Troubleshooting Charts (Cont'd.)

CONDITION	TEST	POSSIBLE CAUSE
	7. Return the Manual/Remote slide switch to Manual. Then measure the voltage at connector 3E6 pin 2 on the main module. You should measure 12 volts DC.	A. Open connection between connector 3E6 pin 2 and connector 6K3 pin 5 on the sweep module.
	8. Unplug connector 3E6 from the main module. Then measure the voltage at connector 3E6 pin 2. You should measure 12 volts DC.	A. Open connection between connector 3E6 pin 2 and connector 6T3 pin 2 on the tuner control module. B. Connector 6T3 not making proper contact with the tuner control.
	9. Measure the voltage at connector 3D3 pin 2. You should measure 25 volts DC.	A. Problem on the sweep module. B. Connector 3D3 is not seated properly.
	10. If all of the above tests were okay, the problem is on the high voltage power supply module.	
CONDITION	**TEST**	**POSSIBLE CAUSE**
Sound is okay. Picture is black except for the time/channel display.		
	1. Measure the voltage at connector 2A7 pin 2. This voltage should be between 0 and 12 volts DC (depends upon the setting of the Black Level Range control).	A. Connector 2A7 pin 2 is not making good contact with the circuit board. B. Problem on the main module.

Troubleshooting Charts (Cont'd.)

CONDITION	TEST	POSSIBLE CAUSE
Sound is okay. Picture is black but high voltage is present (listen for crackling sound from the picture tube when you turn the Set on).		
	1. Look for a filament glow inside the neck of the picture tube. If you see a glow, proceed directly to test 5.	
	2. Unplug connector 5H3 from the CRT socket module. Then measure the resistance between connector 5H3 pin 1 and pin 2. You should measure 2 Ω.	A. Problem on the sweep module.
	3. Measure the resistance between connector 5H3 pins 1 and 2 on the CRT socket module. You should measure 0 Ω.	A. Socket on the CRT socket module is not making good contact with the picture tube. B. Problem on the CRT socket module.
	4. Reconnect connector 5H3 to the CRT socket module and measure the resistance between connector 5H3 pins 1 and 2. You should measure 0 Ω.	A. Open connector 5H3 to CRT socket module.
	5. Unplug connector 2J6 from the main module. If the picture is not normal, the problem is most likely on the tuner control circuit board. If the picture is now normal, reconnect connector 2J6 and proceed to test 6.	



ENLARGED VIEW OF BASE (REAR VIEW)

JEDEC NO. AD BASE WIRING

PIN-1	GRID NO. 4
PIN-3	GRID NO. 3 & 5
PIN-7	HEATER
PIN 8	HEATER
PIN-9	GRID NO. 1
PIN-10	GREEN CATHODE
PIN-11	GRID NO. 2
PIN-12	RED CATHODE
PIN-13	BLUE CATHODE

Troubleshooting Charts (Cont'd.)

CONDITION	TEST	POSSIBLE CAUSE
	6. Measure the voltage at connector 3E6 pin 2 on the main module. You should measure 12 volts DC.	A. Connector 3E6 is not making good contact with the circuit board.
	7. Measure the voltage at connector 6K3 pin 5 on the tuner control module. You should measure 12 volts DC.	A. Connector 6K3 is not making good contact with the circuit board.
	8. Measure the voltage at TP15 on the tuner control module. You should measure 5 VDC.	A. Problem on the tuner control module.
	9. Measure the voltage at connector 5A2 pins 1, 2, and 3. You should measure between 170 and 180 VDC.	A. Problem on the main module.
	10. Measure the voltage at connector 5A2 pin 6. You should measure 18 volts DC.	A. Problem on the main module.
	11. If all of the tests were okay, the problem is most likely on the CRT socket module or the picture tube.	
Bright screen with little or no picture. Picture and Black Level controls have no effect.		
	1. Measure the voltage at connector 3F3 pin 1 on the main module. You should measure 170 volts DC.	A. Connector 3F3 is not making good contact with the circuit board. B. Problem on sweep module.
	2. Measure the voltage at connector 5X3 pin 1 on the video output module. You should measure 600 volts DC.	A. Connector 5X3 is not making good contact with circuit board. B. Problem is on the sweep module.
	3. Measure the voltage on the heat sinks of transistor Q2501, Q2502, and Q2503. You should measure at least 110 volts DC.	A. Problem on the main module.

Troubleshooting Charts (Cont'd.)

CONDITION	TEST	POSSIBLE CAUSE
No vertical deflection. A line is visible across the center of the picture tube screen.		
	1. Measure the voltage at connector 3G3 pins 4 and 5 on the sweep module. You should measure 15 volts DC.	A. Problem on the module.
	2. Unplug connector 2A3 from the sweep module. Then measure the resistance between 2A3 pins 1 and 2 on the module. You should measure 270 Ω.	A. Open connection at connector 2A3 pin 1 or 2. B. Open winding in the yoke (on the neck of the picture tube).
	3. Measure the resistance between connector 2A3 pins 1 and 2 on the sweep module. You should measure 10 Ω.	A. Connector 2A3 is not making good contact with the sweep module.
	4. Reconnect connector 2A3 to the sweep module and measure the voltage at pins 1 and 2. You should measure approximately 15 VDC.	A. Problem is on main module.
Dimly lit screen. Brightness varies with the Picture and Black Level controls. The time/channel display is present on the screen. Sound is normal.		
	1. Measure the voltage at connector 2A7 pin 3 on the main module. You should measure 0-110 volts DC.	A. Problem on the main module.
	2. Measure the voltage at connector 1M pins 1 & 3 on the main module. You should measure 5.0 VDC.	A. Open connection between connector J1 on the IF input of the main module and the VHF/UHF tuner. B. Problem on the main module.
CONDITION	**TEST**	**POSSIBLE CAUSE**
Brightly lit screen. Little or no picture. No horizontal sync (picture floating). Picture and Black Level control have some effect. Sound is normal.		
	1. Measure the voltage at connector 3D3 pin 5 on the main module. You should measure 14 volts AC.	A. Problem on the sweep module.

Troubleshooting Charts (Cont'd.)

CONDITION	TEST	POSSIBLE CAUSE
Brightly lit screen with bright diagonal lines. No time/channel display. Picture and Black Level controls have no effect. Hissing nosie in the sound.		
	1. Measure the voltage at connector 3D3 pin 1 on the main module. You should measure 48 volts AC.	A. Problem on the sweep module.
	2. Measure the voltage at connector 6K3 pin 1 on the tuner control module. You should measure 25 volts DC.	A. Open connection between connector 3D3 on the sweep module and connector 6K3 on the tuner control module. B. Problem on the tuner control module.
Black screen except for the time/channel display. Highlight color may appear when you turn the Color control up (clockwise).		
	1. Measure the voltage at connector 2A7 pin 2 on the main module. You should measure 1.7 volts DC with a black screen.	A. Problem on the main module.

Troubleshooting Charts (Cont'd.)

CONDITION	TEST	POSSIBLE CAUSE
Snow on screen and no picture except for the time/channel display. Hissing noise in the sound.		
	1. Unplug connector 1K from UHF/VHF tuner. Then measure the voltage at connector 1K pin 4. You should measure 24 volts DC.	A. Open connection between connector 3E6 on the main module and connector 1K on the UHF/VHF tuner. (This connection goes from connector 3E6 pin 6, through connector 6K3 pin 6, through connector 6N3 pin 4, to connector 1K pin 4.) B. Problem on the UHF/VHF tuner.
	2. Reconnect connector 1K to the UHF/VHF tuner. Then measure the voltage at connector 3E6 pin 3 on the main module. You should measure −30 volts DC.	A. Problem on the main module.
	3. Measure the voltage at connector 6K3 pin 4 on the tuner control module. You should measure −30 volts DC.	A. Open connection between connector 3E6 on the main module and connector 6K3 on the tuner control module. B. Problem on the tuner control module.

Troubleshooting Charts (Cont'd.)

CONDITION	TEST	POSSIBLE CAUSE
Black screen. No picture, but have a hissing sound.		
	1. Measure the voltage at connector 3E6 pin 2 on the main module. You should measure 12 volts DC.	A. Problem on the main module.
	2. Measure the voltage at connector 6K3 pin 5 on the tuner control. You should measure 12 volts DC.	A. Open connection between connector 3E6 on the module and connector 6K3 on the tuner control module. B. Problem on the tuner control module.

CONDITION	TEST	POSSIBLE CAUSE
No vertical sync (picture rolls vertically).		
	1. Measure the voltage at shorting connector 1N pin 1 or 3 on the main module. You should measure 5 volts DC.	A. Problem on the main module.

CONDITION	TEST	POSSIBLE CAUSE
No horizontal sync (picture is not locked horizontally).		
	1. Measure the voltage at connector 3D3 pin 5 on the main module. You should measure 14 volts AC.	A. Problem on the sweep module.

Troubleshooting Charts (Cont'd.)

CONDITION	TEST	POSSIBLE CAUSE
Picture normal. No sound.		
	1. Measure the voltage at connector 3D3 pin 1 on the main module. You should measure 40 volts AC.	A. Problem on the sweep module.
	2. Measure the voltage at connector 3D3 pin 2 on the main module. You should measure 26 volts DC.	A. Problem on the main module.
	3. Measure the voltage between connector 8A8 pins 1 and 2 on the audio amplifier module. You should measure 27 VAC.	A. Transformer T-2. B. Connector 8S3. C. Connector 8T8.
	4. Measure the voltage at the cathode (banded end) of CR103 on the audio amplifier module. You should measure 36 VDC.	A. Problem on the audio amplifier module.
	5. Measure the voltage at connector 8K6 pin 3 on the audio amplifier module. You should measure 12 VDC.	A. Problem on the audio amplifier module.
	6. Unplug connector 4P9 from the main module and touch pin 3 with your finger, using a small screwdriver for a conductor. You should hear hum from the speakers.	A. Problem on the audio amplifier module.

CONDITION	TEST	POSSIBLE CAUSE
TV works normally. No video input or output at Audio/Video panel jacks.		
	1. Measure the voltage at connector 4O3 pin 2 on the Audio/Video Input/Output module. You should measure 12 VDC.	A. Problem on the main module. B. Cable connectors 4O3 or 3O3.
	2. If you do measure 12 VDC at connector 4O3 pin 2, the problem is on the Audio/Video Input/Output module.	

Troubleshooting Charts (Cont'd.)

CONDITION	TEST	POSSIBLE CAUSE
TV works normally. No audio input or output at Audio/Video panel jacks. Stereo input jacks work normally		
	1. Measure the voltage at connector 4O3 pin 2 on the Audio/Video Input/Output module. You should measure 12 VDC.	A. Problem on the main module. B. Cable connectors 4O3 or 3O3.
	2. If the voltage present at connector 4O3 pin 2 is 12 VDC, the problem is on the Audio/Video Input/Output Module.	

Keyboard Problems

This section shows you how to troubleshoot various keyboard-related problems. Before you begin your search for a channel-change problem, be sure you have correctly entered the channel change. Wait until the time/channel display disappears. Then press the ENTER key and note the channel number that is displayed. It should indicate the channel that you entered. If it does not, first refer to the "Operation" section of this Manual (Page 89) to make sure you are operating the Keyboard correctly.

Tables 6-1 and 6-2 indicate the correct voltages that are required to tune the various bands. LO VHF (channels 2 through 6) and HI VHF (channels 7 through 13) are the same for either normal operation or CATV operation.

BAND	CHANNEL	CONNECTOR					
		6M1 PIN 4 OR 1L1–1K6 PIN 2	6L1 PIN 1 OR 1J6 PIN 4	6L1 PIN 3 OR 1J6 PIN 2	6L1 PIN 2 OR 1J6 PIN 3	6M1 PIN 3 OR 1L1–1K6 PIN 3	6M1 PIN 2 OR 1L1–1K6 PIN 2
LO VHF	2 — 6	−24	1 — 10	12	−23	1 — 10	−23
HI VHF	7 — 13	+10	11 — 25	12	−20	11 — 25	+10
UHF	14 — 83	+10	1 — 28	+2	−20	1 — 28	+10

Table 6-1
Connector DC voltages with NORM/CATV switch at NORM.

BAND	CHANNEL	CONNECTOR					
		6M1 PIN 4 OR 1L1–1K6 PIN 2	6L1 PIN 1 OR 1J6 PIN 4	6L1 PIN 3 OR 1J6 PIN 2	6L1 PIN 2 OR 1J6 PIN 3	6M1 PIN 3 OR 1L1–1K6 PIN 3	6M1 PIN 2 OR 1L1–1K6 PIN 2
MID	0, 1, 14 — 22	11	.5 — 9	12	−20	.5 — 9	10
SUPER & HYPER	23 — 41	10	2 — 12	12	+10	1 — 12	10

Table 6-2
Connector DC voltages with NORM/CATV switch at CATV.
(For CATV mid-band and SUPER/HYPER band channels only.
Channels 2 through 13 are the same as in Table 6-1.)

If any voltage is incorrect, you can unplug the corresponding connector so that you can determine if the problem is on the tuner control module or in the UHF/VHF tuner.

If the bandswitch and supply voltages are correct but the tuning voltage does not vary (change when you select other channels), the problem could simply be an improperly connected cable between the UHF/VHF tuner and the tuner control module.

You can use an oscilloscope to observe the signal at the output of the prescaler. You can also use an AC voltmeter that has a 1 MHz frequency response to measure this signal. Since this voltage is only about .2 volt, stray pickup by the voltmeter leads could make this voltage hard to measure.

When the tuning voltage is fixed at approximately 1 volt DC, the output of the prescaler on all bands is about 1 volt peak-to-peak. The frequency of this signal is slightly less than the lowest tuner oscillator frequency that is require to tune the band, divided by 64. The following chart shows the relationship between the tuner oscillator frequency and the prescaler output frequency for each band.

BAND	TUNER OSCILLATOR FREQUENCY (IN MHz)	PRESCALER OUTPUT FREQUENCY
LO VHF	98	1530 kHz
HI VHF	160	2.5 MHz
UHF	480	7.5 MHz

The keyboard circuit board uses a 4 by 8 matrix arrangement as shown in Tables 6-3 and 6-4. For example, when you push the 7 key, connector 6A6 pin 3 makes contact with connector 6C6 pin 2.

	CONNECTOR				
CONNECTOR	6A6 PIN 5	6A6 PIN 4	6A6 PIN 3	6A6 PIN 2	6A6 PIN 1
6C6 PIN 1	0	1	2	3	POWER
6C6 PIN 2	4	5	6	7	
6C6 PIN 3	8	9			
6C6 PIN 4	ENTER			SKIP	
6B6 PIN 1		CHAN DOWN	VOL DOWN		
6B6 PIN 2	MIN	HR			
6B6 PIN 3	TIME RECALL	CHAN UP	VOL UP		
6B6 PIN 4		ANT 1,2,3,4	CHAN RECALL		

Table 6-3

Basic keyboard matrix.

	CONNECTOR		
CONNECTOR	6D6 PIN 3	6D6 PIN 1	9V PIN 1
6D6 PIN 4	SPCL (AFC)		
6D6 PIN 5	NORM (BAND)		
6D6 PIN 2		REMOTE	
9V PIN 2			ON (RING)

Table 6-4

Control panel switch matrix.

NOTE: Connectors 6D6 pin 4 and 6B6 pin 4 are connected to connectors 6B6 pin 1 and 6A6 pin 6, respectively. Also, connectors 6D6 pin 4 and 6D6 pin 6 are connected through a diode to connectors 6B6 pin 3 and 6C6 pin 4, respectively.

The following troubleshooting chart lists some possible keyboard-releated problems.

CONDITION	TEST	POSSIBLE CAUSE
Single key in the shaded area of Table 6-3 does not operate.	1. Unplug connectors 6A6, 6B6, and 6C6 from the tuner control module.	
	2. Measure the resistance between the connector pins that correspond to the inoperative key. (If key 4 is inoperative, for example, measure the resistance between connector 6C6 pin 2 and connector 6A6 pin 5. The resistance should be 10 Ω when you depress the key.) NOTE: If the key checks okay with the ohmmeter, the problem is on the tuner control.	A. Defective key.
AFC switch does not operate.	1. Unplug connector 6D6 from the tuner control module. Then measure the resistance between connector 6D6 pins 4 and 3. You should measure 0 Ω with the AFC switch at SPCL and infinity with the switch at NORM. NOTE: If you have the correct resistance readings, the problem is on the tuner control module.	A. Defective switch.
BAND switch does not operate.	1. Unplug connector 6D6 from the tuner control module. Then measure the resistance between connector 6D6 pins 5 and 3. You should measure 0 Ω with the BAND switch at NORM and infinity with the switch at CATV. NOTE: If you have the correct resistance readings, the problem is on the tuner control module.	A. Defective switch.
OFF/ON key does not operate.	1. Unplug connector 6C6 and 6A6 from the tuner control module. Then measure the resistance between connector 6C6 pin 1 and 6A6 pin 1. You should measure 10 Ω with the key down and infinity with the key up. NOTE: If you have the correct resistance readings, the problem is on the tuner control.	A. Defective key.

Remote Control Problems

NOTE: The following information assumes that the front panel keyboard operates properly. If you have a problem on the front panel keyboard, refer to "Keyboard Problems" and correct the problem before you attempt to troubleshoot the remote control.

CONDITION	TEST	POSSIBLE CAUSE
Remote control does not operate at all.		
	NOTE: Connect the common voltmeter lead to either of the two shorting clips coming from ground lug N when you make voltage measurements.	A. Manual/Remote switch on the front panel of the TV set not at Remote. B. Battery in the remote transmitter.
	Place the MANUAL/REMOTE switch in the REMOTE position.	
	1. Unplug the connector 6H6 from the tuner control module. Then measure the voltage at connector 6H6 pin 3 on the tuner control module. You should measure 12 volts DC. Reconnect 6H6.	A. Problem on the tuner control module.
	2. Disconnect the plug from the infrared sensor. Measure the voltage at pin 3 of the infrared sensor connector (red wire). You should measure 12 volts DC.	A. Open connection between pin 3 of the infrared sensor assembly connector and connector 6H6 pin 3 on the tuner control module.
	3. Reconnect the connector to the infrared sensor assembly. Be sure the white wire is away from the picture tube. Then again measure the voltage at pin 1 of the connector (red wire). You should measure 12 volts DC.	A. Problem in the infrared sensor assembly.
	4. Measure the DC voltage at pin 2 of the infrared sensor assembly connector (violet wire). You should measure 0 volts DC. Hold the transmitter near and facing the window of the infrared sensor assembly (on the front panel). Press any key on the transmitter and again measure the voltage at pin 2 of the remote pick-up assembly connector (violet wire). You should now measure .1 volt DC (pulsating).	A. Problem in the infrared sensor assembly. B. Problem in the infrared sensor assembly or the remote transmitter.
	5. Remove the battery cover from the remote transmitter and remove the battery. Then measure the voltage across the battery terminals. You should measure 6 volts DC.	A. Battery.

Crosshatch Problems

The following information concerns problems that are related to the crosshatch circuits.

CONDITION	POSSIBLE CAUSE
Very bright white screen when you push switch SW901 to Crosshatch.	A. Open red wire (+25 V) between resistor R3463 on the main module and hole F on the crosshatch circuit board. B. Resistor R921. C. Diode D905. D. Capacitor C904. E. Transistor Q905.
White screen level varies when you adjust the crosshatch control (R911).	A. Integrated circuit U901, U902, or U903.
Vertical lines are okay; no horizontal lines.	A. Open green wire (60 V peak-to-peak) between resistor R2704 on the main module and hole E on the crosshatch circuit board. B. Transistor Q904. C. Integrated circuit U901 or U902. D. Diode D901.
Horizontal lines are okay; vertical lines are slanted.	A. Transistor Q903. B. Integrated circuit U903.
Diagonal dot pattern on the screen.	A. Open violet wire between W52 on the main module and hole C on the crosshatch circuit board. B. Integrated circuit U901 or U902. C. Transistor Q901.
Dots appear in crosshatch pattern.	A. Transistor Q902. B. Integrated circuit U903.
Horizontal lines are okay; no vertical lines.	A. Transistor Q901, Q902 or Q903. B. Integrated circuit U901 or U903. C. Diode D902.
Black screen.	A. Transistors Q901, Q904, or Q905. B. Integrated circuit U901. C. Open yellow wire between resistor R2276 on the main module and hole A on the crosshatch circuit board.

SERVICE FACILITIES

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heathkit Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

Ordering From the Factory

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location where purchased or invoice number.
- Nature of the defect.
- Your shipment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor, MI
49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

Obtaining Replacement Parts From Heathkit Electronic Centers

For your convenience, "over the counter" replacement parts are available from the Heathkit Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heathkit Electronic Center.

NOTE: Parts are only available for the crosshatch, power supply, and the chassis. Parts are not available for the preassembled modules.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. You'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. Do not include the kit Manual. Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shreaded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weights over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

CIRCUIT BOARD MODULE SERVICE POLICY

This color TV receiver was designed to give maximum performance with utmost service simplicity. To help you service your Set, it is sectionalized into circuit boards, or "Modules." You can remove any one of these modules for inspection or service.

This Manual contains troubleshooting procedures to help you isolate troubles to specific modules. Also, our trained technical consultants will assist you by letter or telephone in troubleshooting your Set.

SPECIAL SERVICE FACILITY

Special service facilities have been established at our Heathkit Electronic Centers and factory to exchange TV circuit board modules. After you have isolated troubles to a particular module(s), you may return the module(s) for exchange under this policy. Do not **mail** the module to a Heathkit Electronic Center. You may, however, either take the module(s) to the Center or mail it to the factory.

MODULE SERVICE

In Warranty — If a component proves defective during the 90-day warranty period, the modules will be exchanged with no charge for parts and labor. If the problem is due to a construction error that you have made, there will be a service charge.

Out of Warranty — After the standard 90-day warranty expires, any of the modules that require service and are returned to a Heath service facility will be exchanged at an established rate.

HOW TO RETURN MODULES

Pack the module(s) carefully in a suitable carton. Be sure to use plenty of packing material to protect the module(s). Include the following information in the pack:

1. A letter describing the symptons observed in your TV Set.
2. The Model Number and Production Series Number (refer to the blue and white label).
3. The location, date of purchase, and invoice number.
4. Your complete return address.

Ship the carton by insured parcel post, or UPS, to "Heath Company, Benton Harbor, Michigan 49022, Attn: Service Department."

The above service policy applies only to modules. If a problem appears to be somewhere other than on one of the modules, please check with one of your nearest Heathkit Electronic Centers or our Technical Consultants before you return the Set for service.

INSTRUMENT ALIGNMENT

Instrument realignment of this TV Set is not normally required. The following information is provided in case realignment should be needed at some future time due to parts replacemenet.

WARNING: Do not attempt to align this TV set unless you have had previous TV alignment experience, a thorough knowledge of the theory involved, and the necessary equipment.

NOTE: Clockwise (CW) or counterclockwise (CCW) means the direction of rotation as viewed from the knob end of the control.

The following adjustments are made on the main module as shown in Pictorial 9-1 (Illustration Booklet, Page 27).

AUDIO CIRCUIT

Align the detector coil, L1426 on the main module for minimum sound distortion, using a strong antenna signal.

IF CIRCUIT

1. Place the front panel AFC switch to NORM. Using a weak signal (about 500 μV), adjust the bandpass coil L1204 for maximum AGC voltage on the IF; then turn core CW 1/2 turn.

2. Adjust the oscillator coil (L1230) for 4.2 volts DC at the APC test point.

3. Adjust the DC phase control (R1213) for the best transients during large white-to-black excursions.

4. Adjust the limiter coil (L1209) for minimum buzz in the audio. After you make this adjustment, recheck the phase adjustment in step 4.

5. Select a low VHF channel (2-6) with the voltmeter on the AFC test point. Adjust the 45.75 MHz AFC coil L1210 for the same DC reading as when connector 4L4 AFC defeat pin is shorted to ground.

6. Pull out the IF cable from the VHF/UHF tuner at the IF end. Apply 6 volts DC to the IF AGC test point to cut off the IF. Then adjust the Zero Carrier control (R1244) for 7.0 volts at C2.

HEIGHT RANGE

To change the adjustment **range** of the height control, unplug the shorting bar at 2M and plug it back over the other two circuit board pins.

VERTICAL MODE

To "force" the vertical circuit to operate in the non-standard mode, unplug shorting bar 5M and turn it 90°, then plug it back over the circuit board pins. Use this position only for sources which have erratic vertical sync pulses, such as TV games, computers, or VCR's operating in the "special effect" modes.

COLOR APC

1. Select a strong antenna signal.
2. Switch the Color Sentry off.
3. Set the front panel TINT control to the center of its rotation.
4. Set the COLOR control clockwise.
5. Unplug setup jumper 2J from its NORMAL position, rotate it 90°, and plug it over its SETUP position pins.
6. Adjust the APC adjust control (R2390) slowly until the color bars become wider and fewer in number. Adjust the control until the entire picture is predominately one color. The color may drift slowly from red to green to blue.
7. Return jumper 2J to its NORMAL position.
8. Turn the Set off.

This completes the "Instrument Alignment."

CIRCUIT DESCRIPTION

Refer to the Interconnect Diagram (Illustration Booklet, Page 28), the various Schematic Diagrams (Illustration Booklet, beginning on Page 33) and the Block Diagrams (Illustration Booklet, beginning on Page 28) while you read the following Circuit Description. Circuit components are identified with a combination letter-and-number callout. The letter describes the component; the number locates it in the TV Set and on the Schematic.

VHF/UHF TUNER

Refer to the VHF/UHF Tuner Schematic (Illustration Booklet, Page 33) as you read the following section.

Input

A single 75 Ω, combined VHF/UHF/CATV antenna input connector is used on the tuner. In most cases, this eliminates the need for external splitters or matching transformers. The VHF/UHF tuner electronically selects the desired television signal from 178 channels of regular VHF and UHF, as well as cable television.

VHF Section

The signal is routed to the VHF section by reverse biasing diodes CR1 and CR2. After FM band and IF passband trapping, it is tuned by varactor diode CR1110 and inductors L1118, L1120, L1121, L1122, and L1123 for low, high, super, and hyperband operation. It is then amplified by a dual-gate MOSFET at Q1127. The signal is coupled through a double-tuned matching circuit which consists of varactor diodes CR1102 and CR1107, and inductors L1109 through L1112, L1129 and L1135, to the mixer stage at transistor Q1102. Here the selected and amplified VHF signals are heterodyned with the signal from oscillator transistor Q1126. The resulting difference signal is then amplified by IF amplifier transistor Q1101 and coupled to the tuner output terminal through tuned circuit L1102.

UHF Section

The UHF signal is routed to the UHF tuner section by forward biasing diodes CR1 and CR2. It is tuned by varactor diode CR1180 and inductor L1187, and amplified by RF amplifier transistor Q1177. From the output of Q1177, the signal is coupled through double-tuned varactor/inductor circuits CR1179/L1183 and CR1178/L1181 to the mixer diode CR1177. The signal is mixed with the signal from the oscillator stage Q1176 to produce an intermediate frequency in the 45MHz range. This signal is then amplified by transistors Q1101 and Q1102 which are cascoded when the tuner is on the UHF band.

Tuning voltages, low VHF, high VHF, superband, hyperband, and UHF band switching voltages are applied to the tuner from the tuner control module. IC 1151 is a divide-by-64 integrated circuit which divides the oscillator signal for use by the phase-locked loop.

TUNING SYSTEM

Refer to the Tuner Control Schematic Diagram (Illustration Booklet, Pages 45 and 46) as you read the following section.

The tuning system in this TV Set is formed by four main circuits: keyboard, memory, character generator, and microprocessor and interface. These circuits are each described below.

Keyboard

The microprocessor constantly scans the keyboard by applying negative pulses to eight output lines (KO P10 through KO P13 and KO P20 through KO P23). When you press a key on the keyboard or close one of the slide switches, the pulse returns to the microprocessor on one of the five input lines (KIN P0 through KIN P3 or KIN P30). Each of these input lines has a pull-up resistor that holds the input at a logic 1 when no key is being pressed. When a key is pressed, the microprocessor determines which key is closed and initiates the proper response.

Input line 50/60 Hz is the 60 Hz input for the real time clock. Pullup resistors R6774 and R6791 hold this input line at a logic high during the absence of a positive signal on the base of Q6720.

During the positive half of the 60 Hz line voltage, the signal is applied to the base of transistor Q6720. This causes Q6720 to conduct and essentially grounds the junction of R6774 and R6791. Line 50/60 Hz becomes a logic low for this half cycle. During the other half cycle, Q6720 is off and line 50/60 Hz becomes logic high. The circuits inside the microprocessor use the logic low to logic high transition for the real time clock.

Memory

The memory of this TV Set stores your favorite channels (which you program through the keyboard) so that you can scan the channels without reprogramming each channel after a power interruption.

Memory integrated circuit IC6826 is a special memory IC. It operates similarly to a random access memory (RAM) in that data can be stored in or retrieved from memory. Unlike a RAM, which loses memory when power is removed, the data stored in this memory is retained for up to a year after power is removed.

Addressing, mode of operation, and data are transmitted from the microprocessor (output lines KO P10 through KO P13) to the memory (input lines DA0 through DA3) on four lines. Memory output lines DO0 through DO3 supply data to input lines KIN P0 through KIN P3 on the microprocessor.

To read data from memory, the microprocessor outputs a 4-bit address. Clear line $\overline{CE}$, goes to a logic 0 to enable the memory. As $\overline{CE}$ changes from logic 1 to logic 0, the address is latched into the memory's control circuitry. The microprocessor now outputs a second 4-bit address, which returns $\overline{CE}$ to a logic 1 and latches this address. A 4-bit code instruction is placed on the output lines and $\overline{CE}$ again goes to a logic 0. This causes the instruction to be carried out in the memory IC and the data from the specific address appears on lines DO0 through DO3 for input to the microprocessor.

To write (or store) data into memory, the same sequence is used except that after $\overline{CE}$ is pulled low the second time, the 4 bits of data to be stored are supplied by the microprocessor output lines. When $\overline{CE}$ goes high, data enters the memory control circuits and the write cycle begins. After the write cycle, which takes 100 milliseconds, the microprocessor outputs a stop writing instruction. This pulls $\overline{CE}$ low and stops the writing cycle. Finally, $\overline{CE}$ returns to a logic 1 and the memory is released. Volume control setting information is also stored in the same manner.

To insure against accidental writing into memory upon power up, the PCLR line (which must be logic 0 to write into memory) is pulled to +5 volts through resistor R6853, along with $\overline{CE}$ that is pulled up through diode CR6827. As the +5 volt line rises, capacitor C6851 begins to charge through resistor R6852. Shortly after the +5-volt line reaches the normal level, C6851 becomes charged enough to turn on zener diode CR6851 and transistor Q6860. When Q6860 conducts, the PCLR line becomes logic 0 and diode CR6827 is reverse biased to isolate it from the $\overline{CE}$ line.

Character Generator

The on-screen display is formed by rows and columns of characters. The channel/time display is two rows high and five columns wide.

The microprocessor supplies information on output lines KO P10 through KO P13 and KO P20 through KO P23 to character generator input lines DA0 through DA6, and ADM. When LDI is logic low, which pulls down the LDI input, the microprocessor outputs a 7-bit word. This word is either an address that corresponds to a row and column (for a given character) or an instruction. (The instructions would be display format, enable display, or disable display). As LDI changes to logic high, the 7-bit word latches into the character generator control circuits.

A second word is placed on the output lines, which specifies a character on the data line required to carry out an instruction. At this time, LDI goes back to logic low, which causes the information that is latched in the character generator control circuits to be either stored at the indicated memory location or execute the instruction.

The ADM input on the character generator IC is used for address mode control. This input is a logic low during the time the above operation occurs. If ADM is a logic high, the previously latched address, in the control circuitry, increments by one. Only data for this new memory location is supplied by the microprocessor and is latched by a positive transition of LDI.

An RC network at OSC1 and OSC2 allows you to adjust the internal 4 MHz clock. The character generator utilizes a composite sync pulse input fed directly to an input on the microprocessor. The microprocessor breaks the pulse into the required horizontal and vertical outputs. Horizontal information is derived from a counter, which places the display box on the CRT screen in the location determined by the setting of the set-up potentiomenter.

Outputs VOW and VOB provide the on-screen display. A logic low output at VOB provides a black background, while a logic high output at VOW provides yellow characters. Buffer and driver transistors produce the proper amplitude and polarity. The drivers also interface to the main module to override the video so the appropriate information is displayed on the screen.

Microprocessor and Interface

Crystal CR6760, between the two OSC pins, sets the frequency of the internal 7.16 MHz oscillator. This oscillator provides the clock required for operation of the microprocessor and the reference frequency for the phase-lock-loop (PLL) circuits contained in the microprocessor.

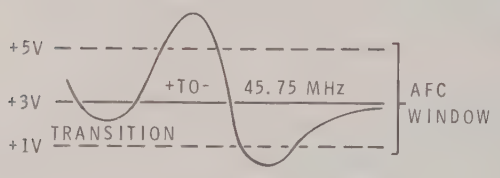
The serial bit stream that is generated in the infrared preamp circuits is applied to the input IR IN, where it is decoded by the microprocessor. The VOL OUT output provides DC voltage in 64 steps, through volume driver transistor Q6776, to adjust the output level of the audio IC.

When a channel is selected, the microprocessor checks the state of the CATV/NORMAL switch and then obtains the required divide ratio for its ROM (read only memory). This causes the internal dividers to produce the required reference frequency for the PLL along with two bits of bandswitch information. The bandswitch logic is latched at outputs LOGIC A and LOGIC B of the microprocessor IC and at B/S and SB/S of the interface IC. This causes the tuner control to select the proper band. Minimum tuning (clamp) voltage is also set for each band to prevent the oscillator in the tuner from stopping due to low tuning voltage.

A prescaler in the tuner divides the tuner oscillator frequencies by 64 before they are applied to the LFI input of the microprocessor. The microprocessor further divides this frequency and then applies it to the PLL circuits. The PLL adjusts the duty cycle of a 2 kHz, 5 volt peak-to-peak output at PD0. This signal is applied through resistor R6788 to OP IN on the interface IC. An operational amplifier that is connected between OP IN and OP OUT is supplied by a 32 volt, 13.6 milliampere constant current supply at ISS.

Resistor R6792 and capacitor C6786 provides feedback from the output to the input for filtering. The filtered DC tuning voltage at OP OUT is applied to the tuners and is adjusted to obtain and maintain phase lock between the oscillator and microprocessor-supplied reference frequency.

In the normal mode, the tuning system always places the tuner oscillator at the correct frequency to receive an FCC-specified channel frequency. At some CATV or MATV installations, the channel oscillator frequencies are offset from the FCC-designated standard. This is done purposely to lessen interference. Some inexpensive TV games also operate on offset frequencies. Provision is made to capture channels that are offset by as much as 3.25 MHz. This feature is activated whenever the AFC switch is in the Special position.



PICTORIAL 8-1

Pull-down resistor R6869 holds the AFC IN input to the microprocessor at logic low, when a logic high is not present at the anode of diodes CR6741 or CR6742. AFC voltage (see Pictorial 10-1) from the IF module is applied to the interface IC at AFC IN. Internally, this voltage is applied to three comparators. The outputs from two of these comparators are connected to the AFC WIND output and produce a logic high if the voltage is in the window (+1 volt to +5 volts). The output of the third comparator is applied to AFC CENT and produces a logic high or logic low, depending upon which side of the center voltage (+3 V) the AFC happens to be. When a channel is selected in the special AFC mode, the system first synthesizes the correct frequency for that channel.

The microprocessor places a logic low on the KO P21 output, which causes the anode of diode CR6742 to become clamped to logic low through resistor R6742. This happens regardless of the AFC window level. The microprocessor now checks input AFC IN. A logic high from the AFC CENT output of the interface IC, applied through diode CR6741, indicates the need for tuning down. A logic low indicates the need for tuning up. The microprocessor steps the tuning voltage in small increments which, in turn, change the tuner oscillator frequency. If the tuning voltage is being stepped down, the microprocessor looks for either a high-to-low transition of the AFC CENT output at AFC IN or looks for a low-to-high transition if it is stepping up. This transition indicates that the center frequency has been found and the stepping ceases. At this time, the processor checks for the validity of the carrier. For a carrier to be valid, the output of the AFC window must be a logic high, and a vertical pulse train must be present at microprocessor input V SYNC. Vertical sync from the sync integrator on the main module is applied to input IV on the interface IC. Here, it passes through a comparator to the V SYNC output. If the carrier is invalid, stepping resumes.

After each tuning voltage step, if the center frequency is not found, output KO P21 goes to a logic high and KO P20 goes to a logic low. This applies the AFC window signal to input AFC IN, which disables AFC CENT. If AFC WIND goes to a logic low, the microprocessor determines that the edge of the AFC window is reached and begins stepping in the opposite direction. If the microprocessor does not find a valid carrier, stepping continues to the other end of the window, where the AFC WIND output again becomes a logic low and stops the stepping action. During the time the system is looking for a valid carrier, the raster is blanked and the sound is muted. When a valid carrier is located, or if the system searches the entire window without finding one, blanking and mute are disabled.

IF AMPLIFIER

Refer to the IF Amp/Detector/AGC Integrated Circuit Block Diagram (Illustration Booklet, Page 30) and the Main Module Schematic (Illustration Booklet, Page 34) as you read the following sections.

The IF amplifier, detector, and AGC circuitry stages shown in the Block Diagram are connected internally in the integrated circuit IC1201.

The signal from the tuner passes through a matching pad, C1226 and L1226, and then to SW IF (surface wave filter). Because the input impedance of the first IF stage is almost purely resistive, it is similar to having the output of the SWIF tuned. The result is that less power is lost in the interface between the SWIF and the first IF amplifier stage.

The IF amplifier consists of five stages of amplification (all of the differential type). The first stage a is grounded base stage to produce the low impedance input. This stage, has no AGC applied to it.

The second and third stages are conventional differential amplifiers. They contain variable emitter degeneration to produce about 23 dB of gain reduction per stage. This variable emitter degeneration is brought about by controlling the forward bias on a diode which parallels the emitter resistor.

The fourth stage is the peaker stage. This stage contains a high Q series-tuned circuit, in the form of a ceramic filter U1203 (called a piezonator) selectively placed across the emitter circuit. This selection is controlled by the AGC voltage acting on a forward-biased diode, similar to the previous AGC stages. When this high Q circuit (which is tuned to the picture carrier) is placed across the emitter, it raises the gain of the stage to the picture carrier, but leaves the gain of the rest of the IF band a constant. The gain to the picture carrier is designed to increase 6 dB at maximum gain, placing the picture carrier at the top of the IF response curve. The rest of the response will remain the same as the strong signal condition.

When the picture carrier changes 6 dB as a function of the AGC voltage, it amounts to 6 dB more gain reduction in the amplifier. This gain reduction, along with the 46 dB gain reduction of the two previous stages, adds to a total gain reduction of 52 dB.

The fifth stage is the output stage. Although the five stages are operated differently, only one output is used in this stage.

The signal from the output amplifier stage, at pin 1 of IC1201, is coupled through capacitors C1210 and C1212 to pin 28 where it is split two ways; one output goes to the synchronous detector stage; the other goes to the limiter stage.

The limiter stage collector circuit contains back-to-back diodes as the main limiting element. The limiter signal is sent to the phase detector. In addition, a part of the limiter output is used to drive the AFC circuitry. The signal that is applied to the phase detector is multiplied by its other input, which becomes the reference oscillator signal. When these two signals are 90° out of phase, the output of the multiplier is zero. At any other phase condition, the output will produce a beat note accompanied by a DC component. This signal is filtered, amplified, and then used to control the VCO (voltage controlled oscillator) reference oscillator.

The VCO signal is applied to the sychronous detector stage through a voltage-controlled phase shift stage. The variable phase shift control R1213, allows the sync detector to be adjusted without affecting the limiter adjustment.

The video amplifier stage provides the correct levels for the C1 and C2 video outputs at pins 16 and 17 of IC1201. The C1 signal is inverted and fed to output pin 16. This action takes place after it overcomes an offset voltage. The C2 output is an emitter follower and is output on pin 17.

A 6-volt regulator functions as a shunt regulator, using a 5.3-volt zener diode as the reference unit to power the internal circuitry of IC1201.

AGC SYSTEM

The ACG function is included in the IC1201 circuitry. However, the sync separator function is included with the horizontal/vertical processor IC2710. Because of the separation of the Sync/AGC into separate ICs, an external circuit is used to provide the function of AGC gate generation.

Sync pulses from the sync output at pin 28 of IC2710, are AC coupled to the flyback gate signal from pin 9. When the sync and flyback gate signals are in phase, the AGC gate signal at the anode of diode CR2736 is mainly sync. However, when the sync pulses are absent, the AGC gate signal is a reduced flyback gate signal. Diode CR2736 attenuates the noise during the non-flyback gate period. From the anode of diode CR2736, the AGC gate signal is coupled through R1236 to pin 14 of IC1201.

The functions of the IF amplifiers, synchronous detector, AGC detector, AGC delay, IF AGC amplifier, and the RF AGC amplifier are all incorporated into IC1201. The functions of the AGC detector are as follows:

1. AGC Detector — Samples the video during the sync period and charges or discharges the AGC filter capacitor C1227 to a voltage which represents the signal strength. The AGC filter voltage, via the AGC delay circuit, is applied to the IF and RF AGC amplifiers.

2. AGC Delay — Adjusts the minimum IF amplifier gain and determines the threshold below which only the IF amplifier's gain is adjusted. Above this threshold, the RF amplifier is adjusted for maximum gain, and the IF amplifier remains at minimum gain.

Capacitor C1233 is connected between pins 12 and 13 of IC1201. For abrupt changes in signal strengths above the AGC threshold, this capacitor causes the IF amplifier to alter its gain and stabilize the video signal. During this transition, the RF amplifier's gain is not altered. After a time, the IF amplifier will return to its minimum gain and the RF amplifier's gain will adjust to a new level which will correspond to the new signal strength.

CHROMA CIRCUIT

Refer to the Chroma IC Block Diagram (Illustration Booklet, Page 30) and Main Module Schematic Diagram (Illustration Booklet, Page 34) while you read the following sections.

The chroma signal is applied to the overdrive limit amplifier input at pin 10 of IC2376. This limiter limits signals of 1 V P-P or larger to aid in speeding the chroma APC pull in. The limiter also provides a DC signal to the ACC pickup noise canceller and the AC chroma signal to the ACC amplifier.

The ACC amplifier is a DC gain-controlled amplifier. In addition to the chroma signal, the ACC amplifier receives an AC signal for pickup noise cancelling and the DC gain control signal from the ACC phase detector via the offset control stage.

The ACC amplifier provides two signal outputs. One is the AC gain-controlled chroma signal, and the other a DC signal to the color killer.

The chroma signal, through C2378, is capacitively coupled from pin 12 to pin 14 on the IC. From pin 14, the signal is fed to an overload limiter, which limits very high level signals to prevent the ACC and APC phase detectors from saturating.

From the limiter, the signal splits and goes to the ACL (automatic color level) limiter and the APC and ACC phase detectors. From the ACL limiter, the signal goes to the burst blanker. The blanker is driven by the burst/clamp gate, which deletes the burst from the signal to allow for the operation of the auto tint circuitry. The chroma, without the burst, is then fed to the color level amplifier along with a DC signal from pin 13 (color level control) and a DC signal from the color killer.

The color level amplifier gain is controlled by the pin 13 voltage. The color level amplifier output feeds the chroma picture control amplifier, which is controlled by the Picture Control in the luminance circuit. The output at pin 16 drives a single tuned, L2378 chroma bandpass filter which, in turn, drives the demodulators at pin 18 of IC2376.

The color killer circuit in the IC has no external filter. It receives a DC signal from the ACC amplifier that is similar to ACC gain. When the gain is sufficiently high, indicating low or nonexistent chroma burst, the color killer cuts off the DC current supply to the color level amplifier.

The APC and ACC phase detectors are double balanced with push-pull outputs. Both detectors receive the chroma signal from pin 14 after the overload limiter. The reference signals are received from the voltage-controlled oscillator (VCO).

The ACC detector receives a signal at the B-Y phase and the APC detector receives a signal at the (R-Y) phase. Therefore, the ACC detector is an amplitude detector and the APC detector is a quadrature phase detector. The ACC detector output is fed through a switchable 2-level offset to the ACC amplifier. Switching the offset changes the reference output level of the ACC amplifier, thus allowing a switchable ACL function. The offset is switched by the auto switch at pin 17. The APC detector drives the VCO phase shift matrix. The output is a DC voltage whose output is proportional to the phase angle between the VCO phase detector input and phase detector burst input. The external feedback path contains an output integrator, R2356 and C2359, a 3.58 MHz crystal, CR2356, and an input integrator, R2355 and C2355.

The required matrixing for the tint control circuit in IC2376 is all performed internally. The signal at pins 26 and 28 are fed to the tint phase shifter. Here, the signals are DC controlled by the voltage at pin 25. The outputs of the phase shifter are four quadrature currents whose phase relative to burst can be changed by $\pm 45°$. These currents are then matrixed to provide the reference phases for the demodulators and are phased 100° apart. The output of the tint matrix is direct coupled to the demodulators.

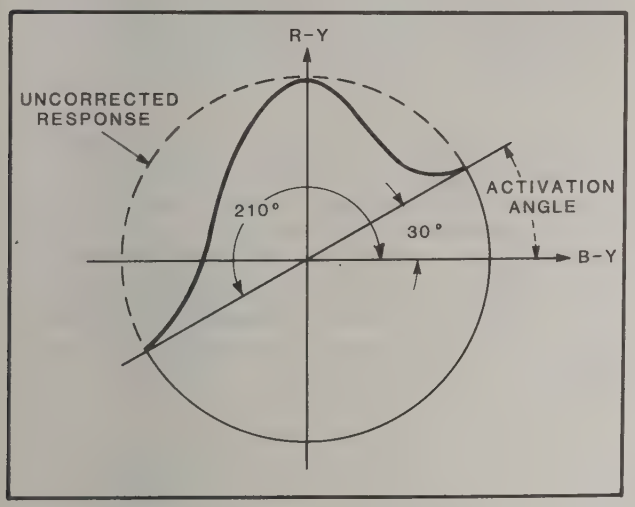
Two double balanced demodulators with a G−Y matrix are used in the IC. Chroma is applied at pin 18 and the subcarrier is applied internally from the tint matrix.

G−Y is derived by matrixing the appropriate currents from B−Y and R−Y The outputs at pins 19, 20, and 21 are positive blue, green, and red respectively.

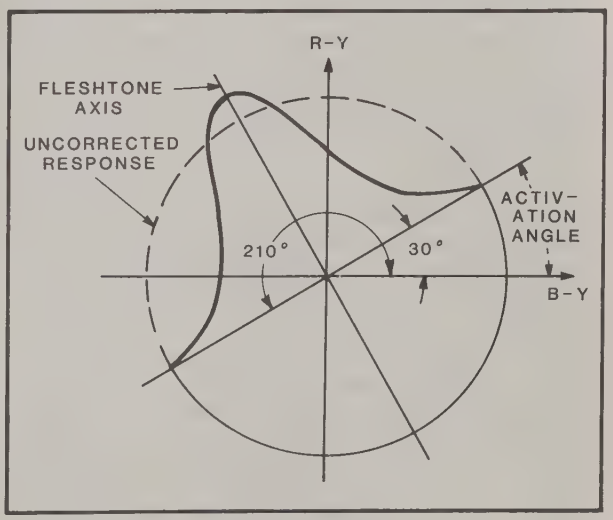
The auto-color system performs three functions. First, it controls the ACL circuitry, second, the auto-tint circuitry, and third, the color killer threshold. It controls the ACL by changing the offset at the output of the ACC detector. This changes the burst level, and correspondingly changes the chroma level to limit over-saturated colors in the auto mode. The change in offset voltage also changes the color killer threshold, allowing the viewer to choose, by means of the Auto switch, the level of color kill.

The auto tint matrix combines portions of B−Y and R−Y to give an "activation" area from about 30°. The matrix is fed to the auto tint comparator and an attenuator. The attenuator establishes a voltage which is proportional to the operating voltages of the R−Y and B−Y demodulators. The sample-and-hold establishes a voltage on a capacitor (C2384) at pin 17 which is the reference voltage for the comparator. The other voltage on the comparator is higher during the burst interval because it is not attenuated. This offset disables the enable circuit. If, during the scan, there is nothing in the 30° to 210° semicircle being demodulated, the comparator is disabled and the system does not correct.

However, if a color is present in the semicircle, the comparator enables the system and the voltage follower and current source are activated. The voltage follower reduces the gain of the B−Y demodulator. This action makes the R−Y axis the preference axis. Colors that are away from the R−Y axis during activation are pulled toward R−Y as shown in Pictorial 8-2. The current source draws current from the B−Y output operating point. This causes the R−Y corrected signal to be pulled to a flesh tone corrected signal as shown in Pictorial 8-3.



PICTORIAL 8-2



PICTORIAL 8-3

LUMINANCE CIRCUIT

The input to the luminance circuitry at pin 2 of IC2376 is driven by 1.5 V P-P video signal from delay line L2276. The input signal is internally buffered and drives a series RLC network used to derive the peaking and low-pass luminance signal.

Inductor L2277 of the RLC network is connected across pins 4 and 6 of the IC. Across this inductor, a second signal is produced, called the "f" signal. This "f" signal is a bidirectional pulse used as the preshoot/overshoot peaking signal. The low-pass luminance signal "f" appears across capacitor C2282 at pin 6. The internal circuitry of the IC can process the common mode luminance and differential mode peaking signals separately. This adds a variable amount of the peaking signal back to the luminance to control the picture sharpness.

The process of adding the peaking signal to the luminance signal is accomplished inside IC2376. Under minimum peaking conditions, pin 1 is at 12 volts, and all the internal signal processing transistors conduct equally. In this state, the positive and negative peaking signals cancel each other and no peaking signal is present in the luminance signal at the video output. As the voltage at pin 1 is decreased, the additive process is decreased, while the amount of peaking signal present in the luminance at the video output increases.

The automatic brightness limiter circuitry is also internal to IC2376 and controls the gain of the video circuitry. With no current flowing through the tertiary winding of the high voltage transformer into the CRT anode, the voltage at pin 3 of the IC is normally at 3.66 volts. This voltage is determined by a resistive/divider network. As current starts to flow into the anode of the CRT, the current is drawn from the junction of resistors RX3210 and RX3206. When the anode current reaches 1.5 mA, the voltage at pin 3 of the IC is normally 3 volts, which activates the internal picture control circuitry. This results in a reduction of the video gain and anode current.

AUTOMATIC CRT TRACKING

Refer to the Main Module Schematic (Illustration Booklet, Page 34) as you read the following section.

The automatic CRT tracking system automatically adjusts the cutoff of the three picture tube guns. The functions of the circuit are in IC2501 on the main module. This integrated circuit can be referred to as the automatic tracking. IC2501 also provides the proper gray scale and black and white tracking under all conditions.

Integrated circuit IC2501 consists of several sections. One color system will be described; the other two operate in the same manner.

Each channel consists of a block called the gate-controlled amplifier, which is an electronic circuit equivalent to the former background control. A DC voltage now controls the proper gray scale and drive levels. In addition to the gate-controlled amplifier, a sample-and-hold circuit has been incorporated. This circuit samples the CRT current at a certain predetermined time and compares the cathode current in the CRT to the internally generated reference. The sampling hold and reference senses any changes and automatically varies the bias and gain of the amplifier to maintain the correct gray scale.

Another block in the IC receives an input from the vertical amplifier and generates a sampling pulse. The purpose of this sampling pulse is to set the CRT at the approximate black level and to sample the current coming from the cathode. Also, it simultaneously turns on the sample-and-hold circuit, which checks the level of the CRT current against the reference, and changes the sample-and-hold voltage and the output voltage accordingly.

The sampling pulse occurs at the end of the vertical blanking interval. By reducing the vertical height so that the raster is underscanned, you can observe the sampling pulse as a very thin gray line above the normal video at the top of the screen. The sampling pulse has a very short time interval. This interval is just before the onset of normal video, during which the IC is actually reading the cathode currents of the CRT and referring them to previous references, which are generated inside the IC. If a current is either too high or too low, a circuit capacitor charges or discharges accordingly. After the sample impulse is over, that capacitor holds a normal voltage and permits normal video to pass.

Three current references inside IC2501 are set to the proper values to produce the three color temperatures, as determined when the CRT is manufactured. Capacitors C2504, C2505, and C2506, which are connected to pins 1, 4, and 7, are the sample-and-hold capacitors. Pin 20 receives information from the vertical deflection circuit at the collector of transistor Q1248. Capacitor C2507 and series resistor R2515, as well as voltage divider resistors R2504 and R2505, are also connected to pin 20. These components serve to generate the internal sampling pulse from the trailing edge of the vertical retrace pulse to coincide with the approximate end of the vertical retrace period.

The voltage at pin 19 of IC2501 is normally low (near ground), but rises to about 6 volts when the sampling pulse occurs, during the sampling period. The resultant pulse is coupled through diodes CR2505 and CR2506 over to pin 15 of IC2376. If the vertical retrace time becomes too long, the sampling pulse could be placed into the video region. If that should occur, the automatic CRT tracking system would not function because it relies upon the blanking leveling from IC2376 to accomplish the automatic tracking. The connection of diodes CR2505 and CR2506, back to the blanking input insures that, whenever the automatic tracking sample pulse is present, the chroma image will be held in the blanking state. This insures that the sampling occurs at a blanking level rather than during an actual video signal.

Pins 2, 5, and 8 of IC2501 are sampling input points. These inputs come from the collectors of the video output amplifiers, Q2506, Q2504, and Q2505. The three CRT cathode currents are sampled by these collectors to the IC.

Vertical-sweep-related circuits are also incorporated on the main module. The vertical signal at pin 16 of IC2710 is connected through resistor-divider R2391 and R2392, and across capacitor C2363. This R/C network integrates the signal to derive a vertical pulse. This vertical pulse drives the base of transistor Q2302, which then goes into saturation during the vertical interval. The base of transistor Q2301 is them pulled down through R2394 and the stage conducts. This action produces a clean vertical interval signal to operate the automatic tracking.

The B+ voltage on the emitter of transistor Q2301 is applied through the transistor and its collector circuit to pin 16 of IC2376, the chroma amplifier emitter-follower output. The presence of B+ at this pin cuts off the chroma output during the vertical interval. Therefore, no chroma or noise can pass through the video system when the automatic CRT tracking is in operation.

VIDEO OUTPUT AMPLIFIERS

The video output amplifier relates to IC2501. Transistors Q2504 (green), Q2505 (red), and Q2506 (blue), are incorporated into the output circuitry. The output amplifier transistors are Q2503 (green), Q2502 (red), and Q2501 (blue).

The amplifier system is a common-emitter circuit whose transistors Q2501, Q2502,and Q2503 drive the CRT cathodes through transistors Q2504, Q2505,and Q2506. Adequate frequency response is obtained by the peaking components, capacitors C2501, C2502, and C2503, and inductors L2584, L2585, L2586, and L2587. These inductors are self-resonant at the second harmonic of the chroma, trapping out 7.2 MHz and preventing its appearance on the CRT screen. In addition, the inductors provide some video peaking in the 2 and 3 MHz range. The emitters of the output amplifier are connected together and are biased by 6.0-volt zener diode CR2504.

All CRT cathode currents flow from connector 2C5 through transistors Q2504, Q2505, and Q2506. The current of the blue cathode flows from pin 6 of 2C5 through inductor L2586, resistor R2586, and transistor Q2506 to pin 2, which is a sampling input of IC2501 as previously described. Similar paths apply to the other two cathode currents.

On the positive transitions of the video signals, diodes CR2503, CR2502, and CR2501, in the base-emitter circuits of transistors Q2504, Q2505, and Q2506, are turned on and conduct the video to the cathodes. Thus, the IC can determine the values of the CRT cathode currents without interfering with the passage of normal video coming from the transistors to the cathodes. Resistors R2510, R2511, and R2512, and capacitors C2522, C2521, and C2520, help suppress arcs that could damage the IC.

CRT GRID (G1) VOLTAGE GENERATION

The fixed DC voltage for G1, the control grid of the picture tube, is developed in a special circuit that couples this voltage to pin 1 of connector 2C5. This circuit has two functions to develop the G1 biasing voltage, and to provide spot-burn protection. The 200-volt source is divided by resistors R2516 and R2517, while capacitor C2509 filters the voltage appearing at pin 1 of connector 2C5.

The other components of the G1 voltage generator circuit form the spot-burn protection. Capacitor C2523 and resistor R2520 form a time constant of several seconds to maintain the G1 voltage after the receiver is turned off. The result is a very brief high brightness condition that discharges the CRT anode voltage quickly when the Set is turned off, to avoid the longer duration high intensity spot on the screen.

MULTIVIBRATOR START-UP SYSTEM

Refer to the HV/HORIZ Sweep Schematic (Illustration Booklet, Page 35) as you read the following section.

The multivibrator start-up system "kick-starts" the horizontal output transistor and sweep circuit directly off the unregulated 150-volt supply.

Transistors Q3213 and Q3224, together with capacitors C3213 and C3224, and resistors R3213, R3214, and R3215, form a stable multivibrator circuit operating off the 150-volt supply. This voltage is developed on the main module when the power is turned on. Thus, the multivibrator also starts oscillating when the receiver is turned on.

The square-wave output voltage on the collector of transistor Q3244 varies between 150 V and ground. The frequency varies with AC line voltage, approximately 10 kHz to 20 kHz for an AC line variation of 80 to 120 volts AC. The duty cycle of the square wave is approximately 70% on and 30% off.

The square wave output current through diode CR3216 and resistor R3216 is connected through connector 3X to an added winding on the horizontal driver transformer T3205 on the sweep module. The oscillating current through this winding is coupled to the driver transformer winding connected to the horizontal output transistor, and causes it to start conducting and to start the sweep circuit, which develops the operating voltages for continued operation of the Set.

Once the receiver is operating, the start-up circuit is no longer needed, and can be turned off.

This turn-off is accomplished by the rest of the circuit shown. Involved are transistor Q3210, capacitor C3210, and resistors R3210 and R3211. Note that Q3210 is connected across the emitter and base of Q3224, one of the multivibrator transistors. When the receiver power switch is first turned ON, the 150 volts is present at both ends of resistors R3210. Thus, both the emitter and the base of Q3210 are at the same potential and Q3210 does not conduct. As operation of the multivibrator continues, a charge begins to build up on capacitor C3210. As soon as this charge reaches the level of 0.7 volts (Q3210 emitter more positive by this amount than the base), Q3210 will turn ON and short out the emitter and base of Q3224, causing this transistor to turn OFF. The oscillation will also stop, as will the flow of current through the start-up winding of the driver transformer.

The multivibrator start-up system has then done its job and the rest of the receiver will take over, with normal drive to the horizontal output transistor and the development of the B+ operating voltages.

The time constant of C3210 and R3210 and R3211 determines the length of time that the multivibrator will oscillate. The usual time is about 130 milliseconds.

VERTICAL OUTPUT CIRCUIT

Refer to the Main Module Schematic (Illustration Booklet, Page 34) as you read the following sections.

The sync separation and the vertical drive functions are done in IC2710. A sawtooth output voltage is produced on capacitor C2118 by charging and discharging it through constant current supplies. The discharge current is varied by the Height control. This changes the peak-to-peak swing of the wave since it always recharges to the same level. Pin 13 of IC2710 is connected to a resistor/capacitor network which constitutes a feedback circuit. The yoke current is sampled by resistors RX2146 and RX2147 and the signal is coupled through capacitors C2131 and C2152 to pin 13 through the feedback circuit.

During the first half of the trace, the output from pin 14 of IC2710 drives transistor Q2149. The collector of Q2149 is coupled through resistor RX2119 to the base of transistor Q2122. This transistor is turned on and controls the current flow from the supply on its collector through pin 5 of connector 3G3 to the yoke. The other side of the yoke incorporates capacitor C2148, which is being charged at this time. As the trace time proceeds, the output at pin 14 of the IC gradually increases, turning transistor Q2149 on harder. This reduces the current flow through transistor Q2122 until it reaches zero. At this point, the yoke current has also dropped to zero.

The second half of the trace is the time interval where the yoke current is going from zero to its peak negative value. The output of IC2710 pin 14 now drives Q2149 on even harder. At this point, Q2122 is off and the current flows from capacitor C2148 (bottom of the yoke) through the yoke, through resistors R2122 and R2123, through diode CR2123, and through Q2149 to ground. Q2149 is gradually turned on harder until maximum reverse yoke current is flowing at the end of the trace.

Q2147 has been off through all of the trace. Q2148 has also been off and capacitor C2149 connected to the collector is charged to slightly over 25 volts. When retrace starts, the output at IC2710 pin 14 goes low, turning Q2149 off. The yoke current does not stop immediately, but flows through diode CR2119 into the power supply. This causes a sudden rise in the voltage at the connection to the yoke. The voltage increase is great enough to be coupled to transistor Q2147 and turn it on. Q2147 causes transistor Q2148 to turn on and go into saturation. The negative side of capacitor C2149 is, in effect, connected to the 26-volt supply through transistor Q2148. Since the capacitor was fully charged, its positive terminal goes to approximately 50 volts above ground. Diode CR2149 keeps the capacitor from discharging into the 26-volt supply. The result is that the collector of the output transistor Q2122 is now operating from a 50-volt supply.

With transistor Q2149 turned off, transistor Q2122 starts to conduct as soon as the yoke current reverses. When the yoke current reaches its proper value, the drive to Q2149 is turned on and the circuit is ready to begin the trace time again. At this point, transistors Q2147 and Q2148 turn off and C2149 starts to discharge. The circuit is now ready to start another trace period.

VERTICAL COUNTDOWN SYSTEM

Refer to the Vertical Countdown Circuit Block Diagram (Illustration Booklet, Page 31) as you read this section.

The vertical countdown system in IC2710 incorporates a G-counter, a clock-phase select circuit, and a reset and VM generation circuit. The G-counter is set at state 380 and generates a 380 μs pulse which is synchronous with the vertical sync pulse of off-the-air signals.

Other than during the vertical sync pulse period, the G-counter is reset at state 52 and starts counting at the leading edge of the next flyback pulse. The clock phase select circuit compares the coincidence of the leading edge of the flyback pulse with the 64fH (fH = horizontal frequency rate) clock, and selects the appropriate clock phase for the G-counter.

Vertical Integrator

The composite sync from the sync separator output at pin 28 is integrated by a dual time constant integrator to remove the horizontal sync pulses and higher order harmonics of the vertical sync. This integrated vertical sync pulse is fed to a shaping circuit via pin 1. The reconstructed vertical sync pulse is used for coincidence detection of the 525 counted pulse of the vertical counter in the phasing circuit.

Phasing (Standard Mode)

An in-phase condition is established if there are seven consecutive coincidences while the system is operating in the non-standard mode. Under this condition, the system will operate at the standard mode if the mode recognition circuit detects nine serrated pulses during the vertical sync period.

When the system is operating in the standard mode, the vertical counter is reset at every 525 counts. A 6-line wide pulse at Vx, derived for the vertical counter, is selected as the vertical drive pulse. As the vertical drive pulse is isolated from the shaped vertical pulse, the vertical deflection is immune to noise.

Phasing (Non-Standard Mode)

An out-of-phase condition is established if there are six consecutive non-coincidences while the system is operating in the standard mode. Under this condition, the vertical system is forced into the non-standard mode, disregarding the mode recognition circuit. The vertical sync signal may have a frequency other than 525 lines (60 Hz), but the mode recognition circuit still can register the nine serrated pulses, providing the false information of the video signal as standard.

When the vertical system is operating in the non-standard mode, the vertical counter is reset by the vertical sync pulses to ensure synchronization with the video VM pulse.

Standard Noisy Signal

A noise detector is enabled for a 184-line period following the vertical sync. Under a noisy condition, the detection of noise will force the system to operate in the standard mode to insure good noise immunity.

Vertical Ramp Generator & Comparator

Refer to the Vertical Ramp Generator/Comparator IC Block Diagram (Illustraton Booklet, Page 28) while you read the following section.

The ramp generator receives its input from the vertical countdown section as a positive drive pulse (VD) six horizontal lines wide (approximately 381 µs wide when in the standard mode of operation). When the pulse (VD) is low, it is buffered and isolated and prevents the ramp capacitor C2118 from discharging.

The level to which the ramp capacitor is charged is determined by a clamp circuit consisting of transistors and a zener diode. When the charge on the ramp capacitor reaches the clamp voltage level, the charging current is shunted to ground by the clamp circuit. As a result, the voltage is maintained at that level for the duration of the VD pulse.

The vertical height section consists of a current source that is controlled by the current flowing into pin 12 and the accompanying resistor/potentiometer network, which determines the current dischage of the ramp capacitor and the amplitude of the vertical ramp waveform.

The feedback from the vertical output is applied to pin 13 for linearity correction. Vertical drive is output at pin 14 to the vertical output section, which was described earlier.

HORIZONTAL SYSTEM

Refer to the Horizontal System Block Diagram (Illustration Booklet, Page 29) while you read the following section.

The video signal is bandwidth-limited by a low-pass filter consisting of R2732 and C2732 to attenuate frequencies higher than 400 kHz, but not to severly degrade the transition time of the horizontal sync pulse.

Sync Separator, Filter & Differentiator

The sync separator has a variable slicing point which is selected to track the midpoint of the sync pulses in the video signal. The sync filter consists of a horizontal and a vertical filter.

Sync pulses are generated at the output of the sync separator, pin 28, while the sync filter is being charged. The broad pulses within the vertical sync pulse of the composite sync signal are differentiated

to 6 μs pulses by the sync differentiator. This differentiated sync signal is used for gating the APC of the phase-locked-loop system. If there is no sync differentiation, the broad pulses during the vertical sync period would cause the PLL to make an incorrect adjustment, forcing the flyback sawtooth to be centered with the broad pulse, thus creating a frequency change at the VCO output. As a result, there may be errors in the AGC gating and burst gating of the vertical countdown system.

APC & APC Filter

The horizontal APC is basically a phase detector circuit. The differentiated sync signal (DS) is compared with the flyback sawtooth waveform FBS. If the SYNC is coincident with the sawtooth, an equal amount of charge/discharge current will flow in and out of the APC filter at any given horizontal sync period. As a result, constant control voltage is present at the output of the APC.

If the SYNC is not coincident with the sawtooth (a phase error, for example), a lagging flyback sawtooth will cause more discharge current from the APC filter, resulting in a drop in the control voltage which controls the VCO to change in frequency, and vice versa. The APC filter consists of resistors and capacitors connected to pin 28 of IC2710.

Master Scan Oscillator

The output of the VCO (master scan oscillator) has a free-running frequency of 1.007 MHz. The VCO has another output where the signal has the same frequency and is conditioned for interfacing. The frequency of this circuit is divided down to the horizontal rate (fH) by a divide-by-64 counter. The twice horizontal frequency (31 kHz) is tapped from the counter for the vertical countdown system. The fH is buffered and fed to the horizontal deflection circuit via pin 3. The flyback pulse is fed to pin 17 and output to pin 19 via a flyback-pulse-shaping circuit. The signal at pin 19 is further conditioned to a sawtooth waveform by a filter consisting of C2705, C2706 and R2705. The sawtooth is then fed to the horizontal APC via pin 20 to close the loop.

HORIZONTAL SWEEP SYSTEM

The bridge rectifier (CR3271 through CR3274), filter LX3224, and C3249A and B provide 150 V to the primary of chopper transformer TX3202.

Horizontal output transistor Q3208, which is in series with the primary of TX3202, controls the stored energy by varying the "on time" inversely to changes in B+. If the B+ decreases, the " on time" must increase to maintain a constant energy level. For a constant energy, current must be constant. The secondary winding of the transformer provides the step-up and phase inversion. During conduction of transistor Q3208, the polarity across the secondary is minus-to-plus. The negative voltage at the anode of load diode CR3211 prevents is conduction and energy is stored in the transformer.

After transistor Q3208 turns off, the voltage on the primary reverses. Therefore, the secondary voltage also reverses, forward-biasing load diode CR3211 releases the stored energy to the system.

The amplitude of the retrace pulse at the collector of Q3208, and also any voltage derived from this pulse on the flyback transformer secondary, are directly proportional to the energy supplied.

Pulse Width Modulator

(Refer to the Main Module Schematic)

A pulse width modulated system provides regulation of the horizontal sweep and sweep-derived voltage for line and load variations.

The pulse width modulator section of IC2710 operates in a closed loop wherein the +95 volts B+ is controlled by feedback from the flyback-derived +26 volt power supply. The 26-volt supply is essentially a measure of the 95 V supply, which in turn is essentially a measure of the high voltage supply.

The pulse width range of operation is determined by the limiter range set by the IC parameters and by the amplitude of the gating sawtooth waveform applied to pin 4.

Maximum pulse width occurs toward low AC line voltage and the minimum pulse width occurs toward high AC line voltage.

The beam current feedback modifies the PW in such a way as to reduce the +95 volts by about 3.5 volts at maximum beam current. Otherwise, the +95-volt supply would be maintained closer to the +95-volt operating point, and thereby affect horizontal size tracking versus beam current. The high voltage to the picture tube is also regulated by the same sequence of events.

In-Phase Driver

This system is an energy storage circuit; storing energy during conduction, and supplying output base drive during the off time of Q3208.

In this system, the driver is part of an in-phase system. When forward driver Q3206 turns on, output transistor Q3208 turns on. The direct drive produces a constant drive level independent of the duty cycle.

A disadvantage is the negative drive current, which is unacceptable for the fast fall time in the output transistor. To maintain a fast fall time in output transistor Q3208, reverse driver transistor Q3209 is added to the circuit. Forward driver transistor Q3206 is driven by IC2710, and reverse driver transistor Q3209 is driven by the collector voltage of Q3206.

Diode CR3207 and resistor R3224 form a clamp circuit which clips (or clamps) the peak of the collector voltage of Q3206. The waveform is coupled to the base of Q3209 by capacitor and resistor R3326. Transistor Q3209 turns "on" after Q3206 turns "off". The current through Q3209, flowing through the primary of T3205, drives the base of output transistor Q3208 negative, producing a "clean" output pulse to switch Q3208 in about .5 microseconds.

After the completion of retrace time, the pulse width modulator is prepared to decide how soon the transistor will "turn on", to begin the energy storage process. Normally operating, the transistor turns on approximately 18 microseconds after retrace time, until the end of the trace. The "turn on" time will vary from 5 microseconds to 30 microseconds after retrace. This "time" variation compensates for line-to-load variation.

Transistor Q3208 is "on" for chopper operation during damper-diode CR3205 time. Diode CR3212 from the damper diode to the transistor, called a blocking diode, is reverse-biased until the damper diode is off. When the cathode of the damper diode goes positive, the blocking diode is forward-biased, clamping the yoke voltage through transistor Q3208. The current through the transistor is a composite of the chopper current and positive yoke current. The transistor "turn off" starts the retrace time.

Transistor Q3208, the damper diode, and the blocking diode are "off." The voltage at the collector of Q3208 rapidly goes positive due to the inductive kick of the regulator transformer. The polarity reversal of the primary of the regulating transformer is also seen on the secondary. The positive voltage at the anode of load diode CR3211, called the injection diode, forward-biases the diode into conduction.

The retrace is produced by the resonant circuitry in the deflection circuit. The added feature is the injection current. Injection diode CR3211 is forward-biased because the anode voltage is increasing faster than the cathode voltage. The injection current aids in charging the retrace capacitor to a constant peak voltage level. The injection diode adds the power lost from the 150 V B+.

During the second half of the retrace time, the retrace capacitor has reached its peak voltage and starts to discharge back into the yoke and flyback transformer TX3204. The injection circuit continues to supply energy during retrace time.

The collector voltage has the conventional retrace pulse of about 800 volts peak-to-peak plus a variable time and amplitude step. The step time is narrow at low line voltage and wide at high line voltage. The amplitude is also equal to the voltage of the unregulated B+ supply, which is dependent upon the line voltage.

Damper diode CR3205 acts in a conventional manner. The damper current starts at the end of the retrace time and ends in the center of scan. Injection diode CR3211 continues to conduct until the pulse width modulator restarts with a requirement for more power.

High Voltage

During the collapse of the magnetic field around TX3204 and the horizontal deflection yoke, a very high voltage is induced into the secondary windings of TX3204. This voltage is rectified to a very high DC potential (26 KV) through a series of transformer windings and diodes. These are inside the flyback transformer. This high voltage is coupled to the anode socket of the CRT. A part of this voltage is coupled to the Focus control. This voltage is then coupled to the focus grids of the CRT.

All of the power supplies in the receiver are derived from the flyback transformer. Although the DC voltages on this transformer can be measured easily, special instruments are required to measure the complex output voltages.

AC POWER SUPPLY

Refer to the Power Supply Schematic, (Illustration Booklet, Page 39) and the Tuner Control Schematic (Illustration Booklet, Pages 45 and 46) while you read the following section.

The neutral side of the line is connected through connector 6R3 pin 1, and 6S3 pin 2 to the primary of transformer T1. It also connects to one side of T301. The hot side of the line is connected through connector 6R3 pin 2 on the main module, and then through a 3/16-ampere fuse (FX6401) and connector 6S3 pin 1 to the other end of the primary of T1. This side of the line also passes through the contacts of relay KX6401 and connector 6R3 pin 3 to the other end of the primary of T301 through 2-ampere fuse FX301.

AC voltage is always applied to transformer T1 whenever the line cord is plugged in and provides the +5 and +12 volts to the tuning and remote control circuits. These voltages must be kept on in order for the remote control receiver to operate.

Transformer T301 is a 1-to-1 isolation transformer that supplies AC line voltage through connector 3R8 pins 1 and 3 to the main module to operate the Set.

IR TRANSMITTER

Refer to the Remote Control Transmitter Schematic (Illustration Booklet, Page 40) while you read the following section.

Initially, the X-ports (IC1 pins 1-5 and 16-18) are set to a logic high output and the Y ports (pins 7-10) are set to sense the input state. When a key is pressed on the transmitter keyboard, a connection is made between the X and Y ports. The Y port senses the key closure and the oscillator is turned on, running for 37 milliseconds to allow for key debounce. Then the Y port senses the column in which the key is located. This information is stored in the X-Y decoder of IC1.

The X-ports are then switched to the input state and the Y-ports are placed in the output state at a logic high level so that they can be sensed at the X-port. The row in which the depressed key is located is sensed at the X-port and stored in the X-Y decoder, and the key scan sequence is complete. At this point, the X-Y discriminator determines which key has been depressed and causes the appropriate command information to be transmitted to the TV Set.

A new type "J" style, 6-volt battery is used to power the transmitter.

CROSSHATCH GENERATOR

Refer to the Crosshatch Schematic, (Illustration Booklet, Page 39) while you read the following section.

The crosshatch generator provides a crosshatch pattern for use during adjustments.

The vertical high signal from the main module at point C is shaped and amplified by transistor Q901 and IC U901D to provide square wave pulses during vertical retrace. Horizontal retrace pulses from the main module at point E are shaped and amplified by transistor Q904 and IC U901A to provide square-wave pulses during horizontal retrace.

Horizontal lines on the screen are generated by dual up-counter IC U902. Vertical pulses at pins 7 and 15 reset the counters. After reset, horizontal pulses applied to pin 1 are counted. Every twentieth horizontal pulse causes pins 6 and 14 to become a high logic for one horizontal line time. Diode D901 and transistor Q905 are turned on, which applies the positive pulse at Y to the main module. This turns on the video output transistors and produces a white horizontal line on the screen. Since two vertical fields make up one vertical frame, a line is produced in each field and appears as a double line.

The vertical lines on the screen are generated by U903, an edge-triggered multivibrator, which is connected as a resettable, astable mulitvibrator. Transistors Q902 and Q903 invert the vertical and horizontal pulses, respectively, which are then applied to U903 pins 3 and 13 to reset the multivibrator. Reset is also applied through resistor R918 to U901B pin 5. This reset operation causes the output of U903 pins 7 and 9 to be logic high. A very short time after, the reset is removed, which is determined by resistor R918 and the input capacitance of U901. Pin 5 of U901 becomes logic high and produces a logic low at IC U901 pin 4 and at the negative trigger input (pin 11) of one-half of U903. Pin 9 of U903 becomes logic low for approximately .4 μs (as determined by resistor R917 and capacitor C903). The logic low at pin 9 causes diode D902 to conduct, which produces a white vertical line on the screen in the same manner that the horizontal lines were produced.

When pin 9 returns to logic high, the rising edge of the waveform triggers the positive trigger input to the other half of the multivibrator. This causes U903 pin 7 to become logic low for approximately 4 μs (as determined by resistor R916 and capacitor C902). At the end of this period, when pin 7 goes back to logic high, U903 is again triggered at pin 11, and the process repeats. The vertical pulse applied to pins 3 and 13 of U903 prevent the multivibrator from operating during vertical retrace.

With the Normal/Crosshatch switch in the Normal position, 26 volts DC is an open circuit. In the Crosshatch position, the 26 volts DC from point F is supplied through resistor R921 to zener diode D905, which produces 16 volts DC for crosshatch operation.

TV AUDIO CIRCUIT

Refer to the Main Module Schematic (Illustration Booklet, Page 34) while you read the following section.

The audio circuit uses IC1451 for its operation. The 4.5 MHz sound IF signal from pin 17 of IC1201 is coupled through ceramic filter U1401 to pins 2 and 3 of IC1451. The ICs functions are as follows: an IF amplifier-limiter, an FM detector, an electronic attenuator, an audio amplifier, and a regulated power supply.

The IF amplifier-limiter amplifies the incoming signal to the point of limiting so that any noise exceeding the limiting point is removed. The output of the IF amplifier is coupled to one input of the FM detector. The other input to the detector is provided by inductor L1426 and capacitor C1426 which make up a quadrature-tuned circuit. This circuit is adjusted to give a 90° phase shift at the 4.5 MHz center frequency of the FM signal. A variation of the input frequency causes a change in the phase shift of the tuned circuit which produces an output voltage. This output voltage is directly proportional to the shift of the input frequency from the center frequency. Thus, the IF signal is converted to audio. The audio signal is then processed by the deemphasis network and the tone control at pin 12 of the IC.

Sound volume is controlled by a DC control voltage through transistor Q1482 to the electronic attenuator at pin 13. The microprocessor varies this DC voltage, which in turn controls the gain of the electronic attenuator. Output signals from the electronic attenuator are then coupled to the audio output section which further amplifies the signal. The output at pin 10 of the IC is coupled through connector 4P9 to audio/video, input/output module connector 4G4 pin 1, and then to the audio amplifier through connector 4E8 pin 2.

IC1451 also contains a sound mute circuit. This circuit is designed to mute distorted audio present when the Set is turned off. The mute transistor inside IC1451, functions in a manner similar to the equivalent circuit of a zener diode, and a backbiased conventional diode when the Set is operating. When the TV Set is turned on, capacitor C1466 across resistor R1462, charges to approximately 18 volts towards B+ through the emitter-base circuit and remains charged while the Set is operating. When the Set is turned off, the 26-volt supply decays rapidly to zero volts. The capacitor, which was charged to approximately 18 volts, now discharges and drives the base of the transistor to a potential of about −.7 volt. This causes the collector-to-base diode junction of the transistor to become forward-biased, pulling pin 4 of IC1462 negative to effect the muting action.

AUDIO OUTPUT AMPLIFIER

Refer to the Audio Amplifier System Block Diagram (Illustration Booklet, Page 32) and the Schematic Diagram (Illustration Booklet, Page 36) while you read the following description.

The TV Set incorporates a 5-watt per channel stereo audio system. A fixed level of audio from the main module, or an external stereo input signal, can be selected by the front panel controls. The block diagram shows the audio signal flow.

Audio Amplifier Module

The left and right channel output amplifiers consist of ICs 101 and 201. The bass, treble, balance, and volume are controlled by DC voltage levels fed to stereo audio processor IC1, which is part of the output amplifier module. The stereo source switch, two control amplifiers, and the DC power supply complete this module.

Audio Electronic Switching

The stereo signal source switch is an emitter follower. Each channel consists of two transistors (Q1, Q3, and Q2, Q4) which share a common emitter resistor. One of the transistors is biased to allow it to transfer a signal while the other has its base held at ground potential. The input signals are applied to the transistor bases whenever the Set is on, but only the biased transistor of each channel feeds its signal to the output of the source switch.

The bias control voltages must be matched and their switching synchronized to prevent pops during the transition from one source to the other. The control amplifier which provides these bias voltages, has its mode set by a switch in the audio control cluster of the front panel.

When the switch is in the TV position, current flows through resistor R17 from the +12 volt supply to turn on transistors Q61 and Q63, and turn off transistor Q62. When the source switch is in the external position and the Space Phone is inactive, transistors Q60, Q61, and Q63 are off, while Q62 is on to activate the external transistors of the emitter follower switch. If the TV Set is switched to the phone mode while the viewer is using the external stereo signals, the control voltage at pin 1 of connector 8K6 is decreased to about 4 volts, and Q60 is saturated. This condition turns on transistors Q61 and Q63 and turns off Q62, during the switch to the TV mode so the telephone signal from the Space Phone module can be fed to the speakers. The switch returns to the external mode when the call is completed and the telephone control voltage switches back to 10 volts.

DC Controlled Balance, Volume, Bass, And Treble Functions

The stereo signal processor IC1 is controlled be DC voltages. Pin 1 is at ground potential, while pin 16 provides input bias to both stereo channels. The input signals for the right and left channels are at pins 15 and 2. Pins 3 and 14 are connected to the treble control capacitors.

When the treble DC control voltage at pin 10 is low, most of the signal in each channel will have high frequencies reduced by these capacitor's circuits. The signals are then fed to the circuits with the bass control capacitors at pins 4 and 13. The signal from the low pass filter, defined by the capacitor at pin 4, is subtracted from a signal without this mid and high frequency roll-off to reduce the low frequency content in the audio signal when the bass control voltage at pin 9 is brought closer to 0 volts. The volume is controlled just before the signals exit from IC1 at pins 6 and 11. A DC voltage above 6 volts at pin 8, allows a high level output from both channels. A control voltage below 0.5 VDC at pin 8 will provide minimum volume.

The balance control modifies the control voltages inside the IC to turn down the volume on the left or right channel. If the balance control voltage at pin 7 is high, the output level of the left channel will be reduced, making the right channel relatively louder. A balance control voltage near 0 V reduces the output level of the right channel.

Pin 12 is connected to the positive +12 volt supply. The control voltage reference, defined by an external voltage divider, is connected to pin 5. The control voltage reference is compared with each of the control voltages to minimize thermal drift and control interaction.

Volume Control Interface

IC1 has maximum output with a high volume control voltage, while the volume control voltage of the TV tuner control module is below 0.9 VDC at maximum volume and 3.2 VDC or higher at minimum volume. The volume control translator amplifier, consisting of transistors Q5, Q6, and Q7, change the direction and range of the DC volume control voltage to provide easy volume adjustment with the remote control.

The amplifier uses a common-base transistor, Q6, whose base is tied to a 3.5 VDC potential to control the current through emitter resistor R37. More current flows when the volume control is lower. When more current flows through the resistor, the current and the voltage across resistor R38 are also greater.

Power Amplifier Circuits

The mute transistor collector-base junctions are used as diodes to shunt the input signal to ground when the amplifier is turned on. The output IC 101 and 102 is a 5-pin high power operational amplifier. The bias is set by the resistive divider connected to pin 1 which is the noninverting input. DC feedback from output pin 4 to the inverting input at pin 2, keeps all pins for maximum swing in both directions. Resistors R106 and R206 are in series with 10 μF capacitors C102 and C202 from pin 2 to ground. This acts as a voltage divider with the resistor at pin 4 to set the amplifier gain.

AUDIO/VIDEO, INPUT/OUTPUT MODULE

The video input signal from the audio/video input/output back panel jack is applied to terminal 4 of connector 2A. It couples through capacitor C1, and resistor R7, to the base of transistor Q2. IC1 clamps to negative-going sync tips of the signal to a set DC level. Transistors Q2, Q3, and Q4 amplify the 1 volt input signal to 2.8 volts peak-to-peak. Inductor L1 and capacitor C4 roll off the high frequencies to correspond to the bandpass of the TV Set's IF amplifier. Noise is also attenuated. From the emitter of Q4, the signal passes through switching diodes CR1 and CR2 to the base of emitter-follower transistor Q19. The signal then is taken from the emitter of Q19, and coupled to the base of emitter-follower transistor Q5, where it appears at the emitter of Q5. From there, it passes out of terminal 1 of connector 4M4 to terminal 3 of connector 1M on the main module, to the luminance channel.

Video signals from the main module are taken from terminal 1 of connector 1M, connected to terminal 3 of connector 4M4, and pass through switching diodes CR4 and CR3 to the base of transistor Q19. From the emitter of Q19, the signal is applied to the base of Q5. From the emitter of Q5, it passes through capacitor C10 to the series-tuned circuit which consists of inductor L3 and capacitor C20 to provide peaking of the high frequencies. Transistor Q10 serves as a buffer stage to drive the emitter of common base stage Q11. The collector of transistor Q11 drives the two PNP/NPN output stage bases. Signal is taken from the emitters of Q12 and Q13, coupled through capacitor C17 to terminal 4 of connector 2B, and on to the jack on the back panel of the Set. Transistors Q6, Q7, and Q8 serve as current drivers to the switching diodes mentioned earlier.

The monophonic audio signal is applied to terminal 2 of connector 2A. It is then coupled through capacitor C100 and resistor R107 to the base of transistor Q102. From the emitter of Q102, the signal is coupled through capacitor C106, to terminal 1 of connector 4P2, on to terminal 2 of connector P2 on the main module, and finally to pin 9 of IC 1451, which is the audio detector and amplifier integrated circuit.

Audio output is taken from terminal 2 of connector 4E8 and couples through capacitor C102 to the base of transistor Q101 which serves as a buffer. From the emitter, the audio passes through resistor R106 and capacitor C103 to terminal 1 of connector 2B, and to the back panel jack. Transistor Q105 is used as a muting switch to mute the regular television program audio when an external audio signal is applied to the input jack.

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Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

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Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

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Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

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